ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XLVIII. No. 4.

CONTENTS.

(16 pages; no insct.)

ENGINEERING NEWS OF THE WEEK..... 57
Hauling Plant for U. S. Navy at East Lamoine, Frenchman's Bay, Me. (illustrated) 58
Different Methods of Hauling Ore at Bingham, Utah (illustrated).. 59
Engineering and Allied Features of the Proposed Charter for Atlanta, Ga..... 61
Book Reviews 62
The Lens Mirror Locomotive Headlight (illustrated). 67
Some Recent Experiments with Cement, Mortar and Concrete..... 67
The Cost of Brick and Stone Block Pavements.... 69
Sewage Purification Works at Island Park Resort, Rome City, Ind. (illustrated) 70
The Need of Technical High Schools in Our Educational System..... 71
Wind Velocity and Fluctuations of Water Level on Lake Erie 72
Drawing Office Record of Work; Indiana Bridge Co. 72
Notes from the Engineering Schools..... 72
EDITORIAL NOTES..... 64
Proposed Charter for Atlanta, Ga.—Government Drainage Investigation—The Fall of the Campanile Explained—The Meter Question at Nashville, Tenn.
EDITORIAL:
The Census Bulletin on the Utilization of Wastes and By-Products..... 64
LETTERS TO THE EDITOR..... 65
Telephone Tunnels and Street Railway Subways in Chicago—The Percentage of Voids in Sand—The Longevity of Timber; Experience, with Sand-Binding Vegetation——The Length of the Vara—Notes of Experience on Masonry Construction—The Appearance of Exposed Surfaces of Concrete.

BIDS FOR THE BROOKLYN EXTENSION of the Rapid Transit Railway were opened by the Rapid Transit Commission of New York on July 21. The Brooklyn Rapid Transit Co. offered to build the tunnel under the East River for $7,000,000 and to provide a system of transfers good over about 90% of the company's lines, in Brooklyn. The Interborough Rapid Transit Co., representing the Belmont-McDonald interests, offered to build the subway for $2,000,000 and to carry passengers between Brooklyn and The Bronx for 5 cts. An alternative bid of $3,000,000 was submitted on the condition that the company should have the privilege of building a subway under Broadway, between Union Square and 42d St. Each of these bids is exclusive of $1,000,000 allowed by the commission for real estate and terminals. Mr. McDonald said that the actual cost of building the tunnel under the East River would be at least $10,000,000; but his company wanted the tunnel in its operating scheme, and could afford to bid lower than any one else. The estimated actual cost of building the proposed Broadway extension is $3,600,000.

THE ONTARIO POWER CO. has obtained from the Queen Victoria Niagara Falls Commission the right to develop 400,000 HP. on the Canadian side of Niagara Falls. The company already possesses the right of taking water from the Welland River, 2,000 ft. above its junction with the Niagara River, and carrying this water to the Canadian Park. Under the new rights the company is permitted to tap the Niagara River at Dufferin Islands, taking sufficient water to develop 200,000 HP. By a short tunnel and a canal through the Park, this water would be led below the Falls. The company is to pay the Canadian Park Commission $15,000 per year for the first 10,000 HP., $10,000 for the second 10,000 HP., and 75 cts. for each horse-power above 20,000, and 50 cts. for all above 30,000 HP. up to 400,000 HP. The sum of $30,000 has been paid by the company to bind the agreement.

THE ST. LAWRENCE POWER CO.'S PLANT at Massena, N. Y., was sold on July 3 to Mark T. Cox, of New York, representing the reorganization committee of first and second mortgage holders. The price paid was $500,000. This plant cost more than $10,000,000; the bonds and stock were largely held in England. The plant is first-class in all its equipments, with a capacity for developing 100,000 to 150,000 HP. The failure of the project was principally due to a lack of power users and purchasers within reach of the plant.

THE HYDRAULIC DREDGE "J. ISRAEL TARTE," has commenced work in deepening the channel in Lake St. Peter, between Montreal and Quebec. This dredge was designed by Mr. A. W. Robinson, M. Am. Soc. C. E., Chief Engineer of the Bucyrus Co., Milwaukee, Wis., and was built by the Polson Iron Works, Toronto, Ont. The steel hull is 160 ft. long, 42 ft. wide, and 12½ ft. deep. The material—blue clay—is excavated by the Robinson patent rotary cutter, and this material is forced by a centrifugal pump through 2,000 ft. of floating steel pipe. It is designed to dredge to a depth of 50 ft. The Montreal "Daily Herald" estimates that this dredge excavated 22,800 cu. yds. in 20 hours.

A CONTRACT FOR DREDGING anchorage grounds at Bird Island, Boston Harbor, and for a 30-ft. channel alongside the government channel, has been jointly awarded by the Massachusetts Harbor and Land Commission to the New England Dredging Co. and the Eastern Dredging Co. for Section 1 of the Bird Island contract at 16.3, 19.3 and 18.5 cts. per cu. yd for the several items. Sections 2, 3 and 4 of the same contract were awarded to G. H. Breymann & Bro., of Toledo, O., at 15, 15.5 and 16 cts. per cu. yd., respectively. Each of these four sections contains about 650,000 cu. yds. of excavation. Of this amount 500,000 cu. yds. must be deposited on the Commonwealth Flats, in South Boston, and much of the balance may also be utilized in raising land at other points.

CHANGES IN THE JEROME PARK RESERVOIR have been severely criticised by a committee of the Merchants' Association of the City of New York, and Mayor Low has been requested to secure a report on the subject from some eminent hydraulic engineer. The committee alleges wastefulness and extravagance in substituting a heavy masonry retaining wall for a heart-wall, and says that the cost of the gate-house is being doubled without apparent reason. The committee also requests an investigation to determine the additional time necessary to effect the substitution of masonry for earth in a portion of the New Croton Dam. It states that an extension of 3½ years' time has already been granted the contractors. The Mayor has informed the committee of the Merchants' Association that its communication has been referred to the President of the Aqueduct Commission. After expressing appreciation of the interest shown by the association, he states, in effect, that the Aqueduct Commission should be heard from before assuming that it "is at fault in connection with the changes of plan at the Croton Dam."

WATER SUPPLY AND SEWAGE DISPOSAL in Minnesota is to be closely supervised by the State Board of Health. It will require plans for all such work to be filed with it, and, it is said, will make a sanitary survey of the waters of the State.

A REFUSE CREMATORY FOR BUFFALO, N. Y., is proposed, to be operated in connection with and supply steam to the Hamburg Canal pumping station. It is also proposed to haul ashes and refuse on the electric railways, instead of by horses and carts. The garbage of the city is and for years has been treated by the reduction process.

THE SLOW SAND FILTRATION PLANT for the water-works of Providence, R. I., is to be built by Messrs. Edward W. Everson and Frederick E. Shaw, both of Providence. The contractors propose to do the work in 200 working days. The contract was awarded on July 15. Mr. Robt. E. Smith is Commissioner of Public Works, and Mr. Otis F. Clapp, M. Am. Soc. C. E., is City Engineer.

DIVISION WALLS IN THE LAWRENCE FILTER BED are to be built by the water board at once. This decision has been reached after a long deliberation and against the advice of the Massachusetts State Board of Health, which recommended that the present filtering area be doubled. The old area will be divided into three beds. The water board has also voted to meter every service from which water is now supplied at meter rates. It is understood that the dividing walls will be built after plans and under the direction of Mr. Arthur D. Marble, City Engineer of Lawrence.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a butting collision between passenger trains on the Lehigh Valley R. R. at Rochester, N. Y., on July 20, in which one person was killed and three fatally injured. The trains were to have passed at a siding other than their regular meeting point under special orders, but one of the trains ran by this siding in disregard of the orders, and as a result the two trains came together at high speed. ——On July 20 a freight train on the Delaware & Hudson Ry. was struck by a landslide near Harpersville, N. Y., and derailed. One man of the train crew was killed and several others injured.

A POWDER EXPLOSION IN A MINE caused great loss of life on July 16 at Park City, Utah. Two powder magazines in the 1,200-ft. level of the Daly-West Mining Co.'s mine at that place exploded from an unknown cause. The concussion was tremendous, but the greater number of the dead were killed by the poisonous gases produced by the explosion. The number of victims is not accurately known, but about fifty bodies have already been recovered. The loss of life may reach near one hundred.

RAIN AND WIND STORMS have done vast amounts of damage all over the eastern half of the country during the past week. The Mississippi Valley and the Atlantic Coast states report damage and loss of life from all points. The continued downpour of rain has produced an exceptional flood in the Mississippi River, which has inundated large stretches of fertile farming country and destroyed a great amount of standing grain. On July 20 a storm of violent intensity broke upon the city of Baltimore, Md., and, though short in duration, caused the loss of about a dozen lives, and much property damage. Hurricane-like storms are reported from points as far west as Minnesota and east to the New England states. A storm in the northeastern states on July 16 and 17 was attended with very intense electrical manifestations; at least a dozen deaths by lightning occurred during this storm in Maine, New Hampshire, New York and Connecticut.

THE 7-MASTED STEEL SCHOONER "Thomas W. Lawson" was launched on July 10 at the yard of the Fore River Ship & Engine Co., Quincy, Mass. This vessel is 403 ft. long over all and 368 ft. on the water line; she has 50 ft. beam and a load draft of 26½ ft. The cargo capacity is about 8,100 tons, and the fully loaded displacement is 10,000 tons. Her masts will be 155 ft. high and they will spread 43,000 sq. ft. of canvas; she has six engines to work the capstan, hoist sail and handle cargo; one of 40 HP. and five of 25 HP. each. The steel hull has a double cellular bottom 4 ft. deep, capable of carrying 1,000 tons of water ballast; supplemented by a trimming tank at each end. She will carry a crew of only 16 men. The "Lawson" will be used to carry coal along the coast, and may later go to the Philippines.

A DOUBLE-HULLED COMBINED RIVER AND GULF steamship is to be built by the St. Louis & Beaumont Transportation Co., on the patents of George O. Rogers. The purpose is to produce a vessel capable of safely navigating both shallow and deep waters. According to the meager press accounts, the vessel will have two hulls; an outer hull with a central wall; with the inner hull complete in itself and divided by bulkheads into compartments for the engines, boilers, crew and cargo. The beam of the inner hull is comparatively small for its length. This inner hull is mounted on hydraulic cylinders connected with the outer hull and with the rams attached to the inner hulls. By this arrangement the inner hull can be raised 6 or 8 ft. above the outer hull, with the bottoms of the two then on the same horizon plane; in this position the vessel draws 4 ft. of water and can enter shallow rivers. When the inner hull is lowered to its lowest point its keel is about 6 ft. below the bottom of the outer shell, and stability is gained for deep-water navigation. The fuel to be used is crude Texas oil; and there will be twin screws with two sets of engines. The advantages claimed are large carrying capacity, low cost of operation and the ability to run well in both shallow and deep water.

A CANAL IMPROVEMENT COMMISSION IN FRANCE recommends that the government spend $128,045,850 in deepening, broadening and connecting various French waterways. A bill to carry out the plan has passed the lower House, raising the amount involved to over $134,000,000; and engineers express the opinion that the improvements proposed will really cost from $173,000,000 to $193,000,000. The strongest argument against the scheme is the quasi partnership between the railways and the State, and the fact that the avowed purpose of the project is to increase the water traffic at the expense of traffic by rail. Mr. John C. Covert, U. S. Consul at Lyons, believes that work will be commenced upon the canals, notwithstanding the above opposition, and he advises Americans engaged in enterprises of this kind to have some one in France to look after their interests in this connection.

PROGRESS ON THE SIMPLON TUNNEL during the month of May is reported as follows: The north heading advanced 660 ft., a mean daily advance of 21.3 ft.; the south heading 299 ft.; total advance of headings during May 959 ft. The total advance of headings to date is 38,628 ft., of which 23,711 ft. is in the north end, 14,917 ft. in the south end. The working force averaged 3,302 during May, 2,241 being employed within the tunnel and 1,061 outside. The north heading during the whole month continued in green crystalline slate and slaty gneiss. The south heading advanced through mica schist, which was quite soft in places, and also encountered a stratum of white limestone. Machine drilling was resumed in the south heading on May 20.

THE CANTON-HANKOW RAILWAY CONTRACT, held by the American-China Development Co., has been ratified and its construction decreed by the Chinese authorities. This contract ratifies one signed in July, 1900, by the Chinese Minister at Washington and the company's representatives. The contract provides for the issuance of $40,000,000 50-year, 5% gold bonds by the Chinese government secured by the railway property. Hankow is 650 miles south of Pekin; including branch lines the system between Hankow and Canton will be 900 miles long. From Canton the line will probably be extended to a point on the mainland opposite Hongkong, a distance of 130 miles. A Belgian syndicate is building the Pekin-Hankow line, and an English syndicate is said to be ready to undertake the Hongkong connecting line.

COALING PLANT FOR U. S. NAVY AT EAST LAMOINE, FRENCHMAN'S BAY, MAINE.

By J. A. McNicol, M. Am. Soc. C. E.*

During the summer of 1901 the Bureau of Equipment, U. S. Navy, advertised for bids and designs for a coaling plant at East Lamoine, Frenchman's Bay, Me., the requirements being a coaling station, with a storage capacity of 10,000 tons of coal, and with a main pier reaching out to deep water, and the necessary coal handling towers and machinery for coaling war vessels of all kinds. A number of engineers and contractors

FIG. 1. GENERAL VIEW OF COAL HANDLING PLANT FOR THE UNITED STATES NAVY AT FRENCHMAN'S BAY, MAINE.
Snare & Triest, New York City, Designers and Builders.

submitted designs in answer to this advertisement, but all of these designs were set aside as being unsatisfactory to the Bureau in some essential feature, and the work was readvertised, with somewhat more definite specifications as to what was required to meet the views of the department. From the second set of designs submitted, that of Messrs. Snare & Triest, of New York city, was selected as that meeting the requirements of the Bureau, and the contract for this important work was awarded to this firm. A brief description of the work follows.

The plant comprises, first, a building 380 by 105 ft., located on the shore, and parallel to the main pier, which is 402 ft. long and 48 ft. wide, with the outer edge in water 32 ft. deep at the lowest stage of low water, and with the main deck at an elevation of 19 ft. above mean low water; and, second, an approach pier connecting the building with the main pier at one end, giving access to the main pier from the shore, and carrying the cable tracks to the building. The approach pier is 32 ft. in width and 240 ft. in length, with a solid embankment approach of about 160 ft.

The location selected is one well suited for the purpose, being on a flat sandy beach, with gradual descent to the outer face of main pier, where it becomes more abrupt. At this point the depth of sand, gravel and clay overlying the rock is about 12 ft. and a depth of 32 ft. below M. L. W. The elevation of the ground at the building is about 16 ft. above low water.

The wall of the building next the water, and the retaining walls of the approach embankment are carried on spruce piling; as is also a part of the interior partition walls where the gravel was too soft for good foundations. The lower track level or ground floor of the building is at grade +16 above M. L. W.; the coal floor at grade 24; and the upper tracks at grade +49. The floor is constructed of steel beams and concrete arches, resting on supports about 10 ft. apart, running lengthwise of the building. The intermediate supports are stone walls 2 ft. thick, and the supports next the outer walls are steel columns, giving open space for storing bagged coal next the outer tracks. In the floor over the sixth main lines of tunnels thus formed by dividing walls are located hoppers and valves every 12 ft. for the delivery of coal into cars, thus giving access to the coal at a great many points in the floor, and permitting its removal from any point which may become overheated.

Partitions of fireproof construction divide the lower strata of coal into three sections, thus limiting somewhat the spread of combustion in the lower sections. The superstructure is of steel construction covered with corrugated iron, and ample light and ventilation are provided by louvres and windows in the monitor. Additional ventilation is provided under the eaves. Means for ascertaining the temperature of the coal are provided by 4-in. galvanized iron perforated tubes, placed about 30 ft. apart and opening into the tunnels underneath.

All of the walls of the building and the retaining wall of the approach wharf are of first-class rubble masonry of granite laid in Portland cement mortar, up to high water line, and above that line in Rosendale cement mortar.

The supporting piles of both main and approach piers are of steel. Those for the main pier being 11 ins. outside diameter and ½-in. thick, four piles to a bent being used, and the bents being placed 10 ft. apart lengthways of pier. For the approach pier piles 8 ins. in diameter and ½-in. thick are used, three piles to a bent being used and the bents being spaced about 12 ft. apart c. to c. The piles are made up in sections of about 20-ft. lengths, connected by steel sleeves securely bolted to the sections. The piles were shod by a heavy cast-iron shoe of conical form, and driven to rock by a drop hammer. After being driven they were filled with concrete and capped with steel plates. The cross girders are composed of heavy beams riveted to the steel cap plates, and have lugs to which the hard pine stringers are bolted. Two lines of rigid cross bracing in each bent of piles are used in the main pier, and extend about 12 ft. below low water. The lower bracing of galvanized angles is connected to the piles by sleeves and pins, and above low water are riveted to sleeves on the piles. One continuous set of longitudinal bracing in each line of piles, and extending down to low water, is connected by riveting to the sleeves, and one line of stiff horizontal bracing is riveted to the steel cap plates. The outer and inner [illegible] of the main pier are protected by fender [illegible] of oak and chestnut bolted to the fender and guard timbers at each bent. The face and ends of the main pier are further protected by dolphins formed of clumps of piles, and by boom fenders.

A steel trestle along the whole length of the approach and the main piers and connecting with the building, carries the cable tracks and leaves the main pier free from cables to permit clear access to vessels.

Two movable towers carrying the machinery for loading and unloading coal, travel along the face of the pier for a length of about 300 ft., and are each equipped with two booms, one of about 75 ft. effective reach on the deep water side, and one of 35 ft. reach on the other side. These towers are so constructed that coal can be transferred directly from lighters on one side to war vessels on the other side of the pier. The towers are equipped with very heavy engines for handling the coal quickly and for moving the towers. In each tower is constructed a steel hopper of about 25 tons capacity, with controlling valve for loading the cable cars which pass immediately under and transfer the coal directly to the building in self-dumping cars of about two tons capacity. During the official test of the working capacity of the plant, coal was transferred from lighter to the building at the rate of 140 and 150 tons per hour, with one tower working.

As the contract for the work was not awarded until Nov. 23, 1901, very little work could be done during the winter, except the building of a temporary pier and buildings for the prosecution of the work during the short summer season. The original contract was, however, completed in May, 1902. To protect the steel piles of the main pier from corrosion, however, an additional contract was entered into, and the work is now being carried on. This consists of enclosing the lower part of the piles in a casing of concrete extending several feet below the mud. Above the mud line expanded metal and concrete 6 ins. thick is being put on. The work is done by divers, and it is believed will prolong the life of the piles indefinitely.

The coal handling machinery was manufactured and installed by the J. A. Mead Manufacturing Co. of New York. The work was carried on under the supervision of the Bureau of Equipment, U. S. Navy, Royal B. Bradford, Chief, and the inspection under L. C. Logan, Commander U. S. N.

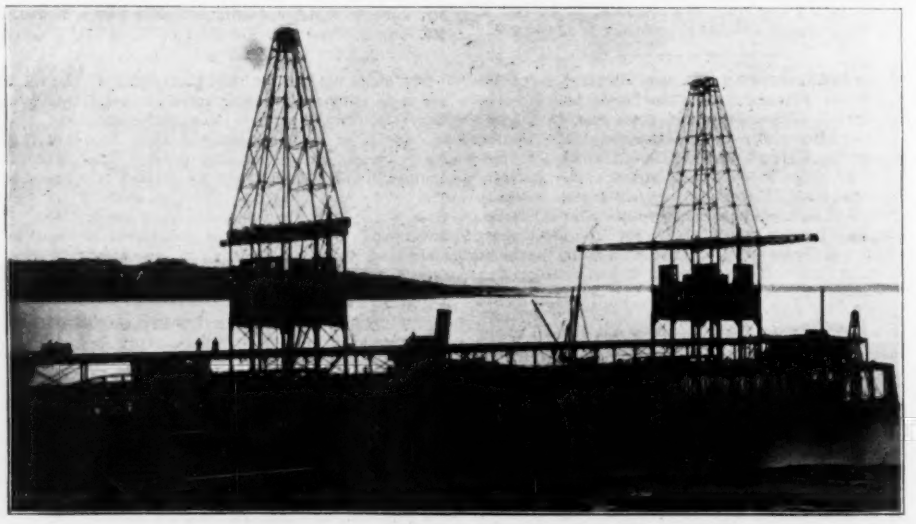


FIG. 2. VIEW OF MAIN PIER, SHOWING COAL HANDLING TOWERS.

*Engineer for Snare & Triest, 39 Cortlandt St., New York city.

A BRICK-LAYING MACHINE, invented in Canada, is said to lay from 400 to 600 bricks per hour, with the assistance of two men and a boy to work it. The idea does not seem to be received with favor by builders in this city. It is claimed that on plain work bricklayers can now lay 250 bricks per hour, or almost as much as the machine and its two men. It is also doubtful if it could be used to advantage in skeleton construction. Similar machines have been invented before, but they were never commercially useful.

DIFFERENT METHODS OF HAULING ORE AT BINGHAM, UTAH.

By W. P. Hardesty, C. E.*

The mining camp of Bingham, Utah, is situated ... miles southwesterly from Salt Lake City. It has long been famous as a producer of silver and lead ores, and during the past three or four years has become a heavy producer of copper also. The canyon of Bingham is reached by a branch of the Rio Grande Western Ry., 14 miles long, connecting with the main line at a point 11 miles south of Salt Lake City. The mining district lies on the eastern slope of the Oquirrh Mountains, and is cut by the canyon of Bingham Creek, which

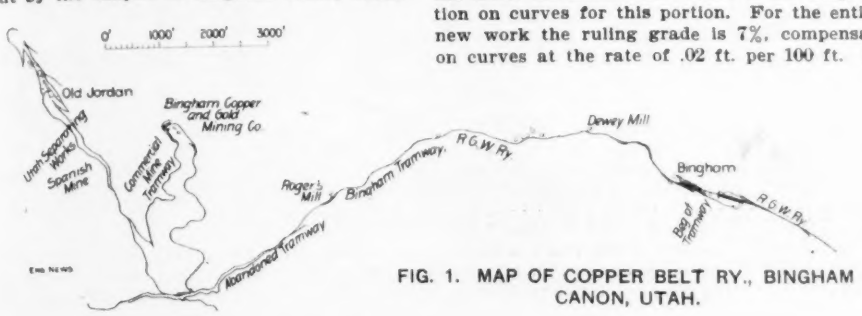


FIG. 1. MAP OF COPPER BELT RY., BINGHAM CANON, UTAH.

heads near the summit and runs northeasterly for a distance of seven miles before debouching into the Salt Lake Valley. The Rio Grande Western Ry. has an average grade of about 3% for the last three miles into Bingham.

The principal mines of the camp lie back farther than the terminus of the road, mostly either up Bingham Canyon or the large gulches that enter it. The hauling of the ores from the mines down to the railroad has always been quite an item. Until recently this has been done either by wagon or by horse tramways, two of which were built to reach some of the principal mines. The slope of the canyon and of the hills is such as to prohibit a railroad of the ordinary kind from reaching the mines without much and expensive development. Some very thorough surveys made several years ago demonstrated this conclusively.

In 1899 several quite large consolidations of mining properties were formed. For the large output of copper and other ores that was now planned for, a more economical means of transportation down to the railroad was desirable. The Bingham Copper & Gold Mining Co., which owns some valuable properties, has made the principal improvements in this direction.

COPPER BELT RAILROAD.

This road, for the greater part of its length, follows very closely the line and grade of an old horse tramway, used to haul ores from the Old Jordan and Galena mines. This tramway is displaced by the steam road as far as it is followed, about 1¾ miles. The new road starts from the terminus of the Rio Grande Western, at the lower end of the town. It follows along the east side of Bingham Canyon for 2⅛ miles, generally at a short distance above the bottom. It then crosses to the west side of the creek, and, by a development along the hillside which causes it to work slightly back along the side of the main canyon reaches the terminus, 2.9 miles from the beginning. This terminus is about 600 ft. northeast from the Commercial Mine, from which it receives the ore by a gravity tramway.

The line is nearly all in curve. There are many 30° curves and one 34° curve in the first two miles. Beyond there are several 40° curves, on one of which is located a trestle with eleven 15-ft. spans. There is a stretch of 3.7% grade at the beginning; for the rest of the way, where the old tram grade is used, it averages from 7% to 7.4%, the latter the maximum. There is no compensation on curves for this portion. For the entirely new work the ruling grade is 7%, compensated on curves at the rate of .02 ft. per 100 ft. The elevations above sea level of the terminals are 5,890 and 6,915 ft. The maximum cut and fill are each about 25 ft. The road is standard gage, with 52-lb. rails on a 14-ft. roadbed. A 50-ton Shay locomotive, with three cylinders on a side, is used. The 100,000-lb. capacity steel ore cars of the R. G. W. Ry. are used, together with all standard cars that may be transferred from the R. G. W. The Shay engine easily hauls three empties up and handles three loads down the grade.

Construction of the road was begun Nov. 1, 1900, and completed Feb. 1, 1901.

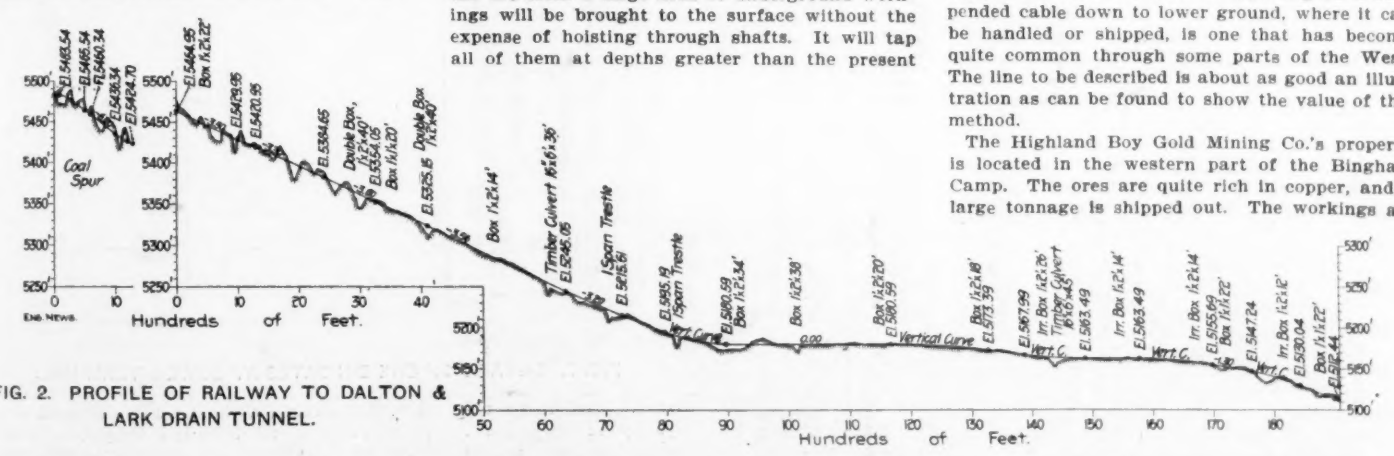


FIG. 2. PROFILE OF RAILWAY TO DALTON & LARK DRAIN TUNNEL.

ROAD TO DALTON & LARK DRAIN TUNNEL

This road was built to reach the mouth of the Dalton & Lark Drain Tunnel, still under construction, and which is designed to drain the workings of the mine of the same name. The tunnel will be about 7,000 ft. long when finally completed, and will drain other connected properties, and will eventually serve as a grand avenue by which the ore from a large area of underground workings will be brought to the surface without the expense of hoisting through shafts. It will tap all of them at depths greater than the present shafts reach, and will drain off the shafts and workings of the Dalton & Lark and other well-known mines which have been filled with water for years. The ore from these mines had for many years been hauled over a tramway connecting with the Rio Grande Western Ry. at Lead Mine Station, three miles below the Bingham terminus. This tramway had a total length of nearly four miles and grades far beyond the limits of a steam road.

The new road leaves the Rio Grande Western Ry. at Revere Station, nearly 3½ miles below Lead Mine Station. The elevation here is 5,112 ft. and at the upper end it is 5,465 ft. The latter is about 1,000 ft. lower than the mouth of the shaft of the Dalton & Lark Mine, formerly reached by the tramway. The length is 3.6 miles. The topography allows of a very good alinement. There is one tangent 1¼ miles long. Of the seven curves the sharpest one is a 12° 30′ curve, followed by three 8° curves. The grade varies from level to 3.6%, and is compensated on curves at the rate of .04 ft. per station. Near the upper end a coal spur (for delivery of coal to coal chutes at a power house) leaves the main line and attains an elevation of about 20 ft. higher. The track is laid with 56-lb. rails on a 14-ft. roadbed.

The equipment is of the same kind as for the Copper Belt road. The Shay engine will handle a train of five cars on the grades of this line. Construction was begun Oct. 1, 1901, and completed Jan. 1, 1902.

Both the above described steam roads were built under the supervision of the Rio Grande Western Ry. Engineering Department, and the writer is under obligations to Mr. F. E. Baxter, Division Engineer for the Utah lines, for data and plans. The two roads were located by Mr. S. J. Norris. They are operated by a railroad department of the Bingham Copper & Gold Mining Co. Mr. D. McVichie is General Manager of the company and Mr. W. S. Hall is Superintendent of the roads.

To provide for hauling the ore which will be produced during the time before all work will be done so that connections can be made between the workings of the several mines and the drain tunnel (probably several years hence), an electric railroad has been built. This is a continuation of the steam road. It is a 24-in. gage line, operated with 10-ton motor cars. The grade is 5%, compensated. The sharpest curves have a radius of between 55 and 60 ft. The line is extensively developed, following the grade contour closely. Four miles have been built and put in operation, by which the present working shaft of the Dalton & Lark Mine has been reached. This is nearly directly up the mountain side from the mouth of the drain tunnel, but about 1,000 ft. higher in elevation.

Water has to be pumped from the mine, and all the ore hoisted until connection can be made with the tunnel. The electric road will be extended on about two miles further to the working shaft of the Brooklyn Mine, about 350 ft. higher in elevation. This work is done under the direct supervision of the mining company.

HIGHLAND BOY AERIAL TRAMWAY.

The method of conveying ore from the mines that are difficult to reach by a surface line, by means of buckets or carriers traveling on a suspended cable down to lower ground, where it can be handled or shipped, is one that has become quite common through some parts of the West. The line to be described is about as good an illustration as can be found to show the value of this method.

The Highland Boy Gold Mining Co.'s property is located in the western part of the Bingham Camp. The ores are quite rich in copper, and a large tonnage is shipped out. The workings are located in Carr Fork, the principal fork of Bingham Canyon. The locality would be difficult to reach with a steam road, the fall of the gulch being rapid and development being difficult.

The ore was formerly hauled down to the railroad in wagons. With the enlargement of the properties and production of the company, it was decided to build an aerial tramway, after complete surveys had demonstrated that a surface line was hardly practicable.

The Bleichert system of cable carriage is used, and the line was built and all equipment furnished by the Trenton Iron Co., of Trenton, N. J. The line is on tangent throughout. The original length was 2⅛ miles, but by a change in the location of the loading terminal it was reduced to 2¼ miles. The profile, drawn to natural scale, shows

*310 Progress Building, Salt Lake City, Utah.

the mountainous route and also the location and height of the towers for supporting the cables. The ground elevation ranges from less than 5,900 ft. at the lower end to about 6,900 ft. at the upper one. The spacing between the towers varies from 152 ft. to about 870 ft. Where several towers are required to round off an abrupt change in grade they are spaced from 15 to 75 ft. The height of the towers varies from 14 to 70 ft. The greatest height of the cable above the ground is over 200 ft. There are 44 towers on the line.

The plans for the 25-ft. tower, about the average height, are practically standard for all. They show the side supports for the cables. Planks are laid on the sills and loaded with stone, to anchor the towers against swaying or tipping over.

The original design of spacing and heights of towers has proven to be excellent, with only one change being needed. Just north of the anchorage station (next described) the great length of span, combined with the steep incline, caused too sharp a turn in the cables, with resultant wear. So the two towers just north of the station were lowered 3 or 4 ft., while an additional tower was put in about 125 or 150 ft. further down. This effected the desired improvement.

At about one mile from the lower end is located an anchor station. Here the track cables from the opposite directions are anchored to a strong framework. By pulling in opposite directions they nearly counterbalance one another. They pass over supports and down on an incline to the anchor. The gap on the line between the supports is filled by an iron hanger bar. The traction cable is continuous.

At about 0.6 mile further up a tension station is located. Here each track cable coming in passes over a sheave to a tension weight below. The horizontal pull in opposite directions is nearly balanced by connecting the two. Provision for a varying length of the track cable is necessary because of the effect of heat and cold.

There are two track cables, one for the loaded buckets and one for the empties. Originally these were 1⅛ ins. and ⅞-in. diameter, respectively, but when the tonnage was to be increased the 1⅛-in. cable was left on for the empties and the ⅞-in. one was displaced by a 1¼-in. cable for the loads. They are of the patent lock-coil track cable type. A ¾-in. Langley traction cable is used. The track cable is supported at the ends of an arm at top of the tower, and the traction cable runs on pulleys 6 ft. lower down.

The loading terminal is located so that tram cars loaded with ore, after being run out of the working tunnel of the mine, are run on a trestle into the building and dumped into ore bins directly over the loading track. The traction cable makes two turns around a bull-wheel by which friction enough is secured to allow of control of the cable by the wheel. Power can be applied by means of a horizontal shaft in the room below, beveled gearing on it engaging beveled gearing on the vertical shaft of the bull-wheel. Ordinarily no power is needed, but brakes have to be applied for regulation of the traction cable. This is because of the great excess of weight on the loaded side, acting by gravity through the 1,000-ft. fall to the discharge terminal. In starting up or when the buckets are all empty, power has to be applied.

There are 116 buckets used on the line at once. Each has a capacity of 4½ cu. ft., weighing about 290 lbs. complete, and carrying about 700 lbs. of ore. They are spaced about 205 ft. apart, and travel at a rate of about 350 ft. per minute. Ordinarily about 105 loads per hour are run over the line. About 500 tons per day of 15 hours (1½ shifts) is the usual day's work for the line.

The buckets have a strong and elaborate gripping device, by which they are fastened to the traction cable. By a swivel connection between this and the bucket, the latter maintains an upright position when the track cable is on an incline of as much as 50° from the horizontal.

On entering the loading terminal building handle of the grip of each empty bucket st a projecting arm and is forced upward, an the grip is released. The bucket here leaves cable and runs on to a hanger bar (a conti tion of the track cable), around which it tra by momentum to the loading place. The bu is filled through one of the ore chutes, opera by an attendant. It is then pushed forward the outgoing track cable. The spacing of buckets is regulated by the revolutions of bull-wheel actuating certain mechanism rings a bell at the required intervals, at which attendant fastens the grip and starts the buc

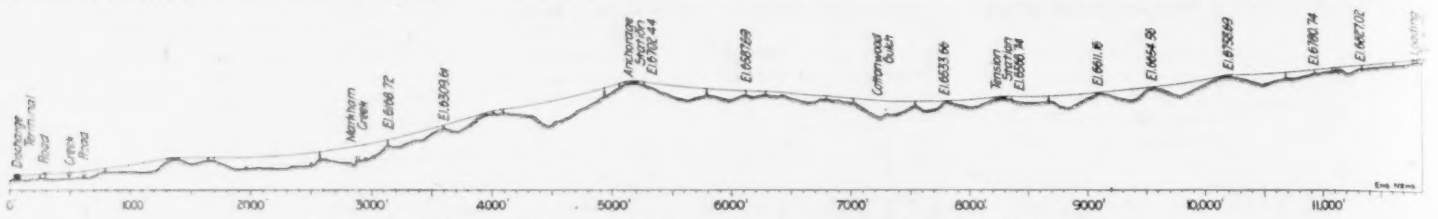


FIG. 3. PROFILE OF BLEICHERT TRAMWAY FOR HIGHLAND BOY GOLD MINING CO.

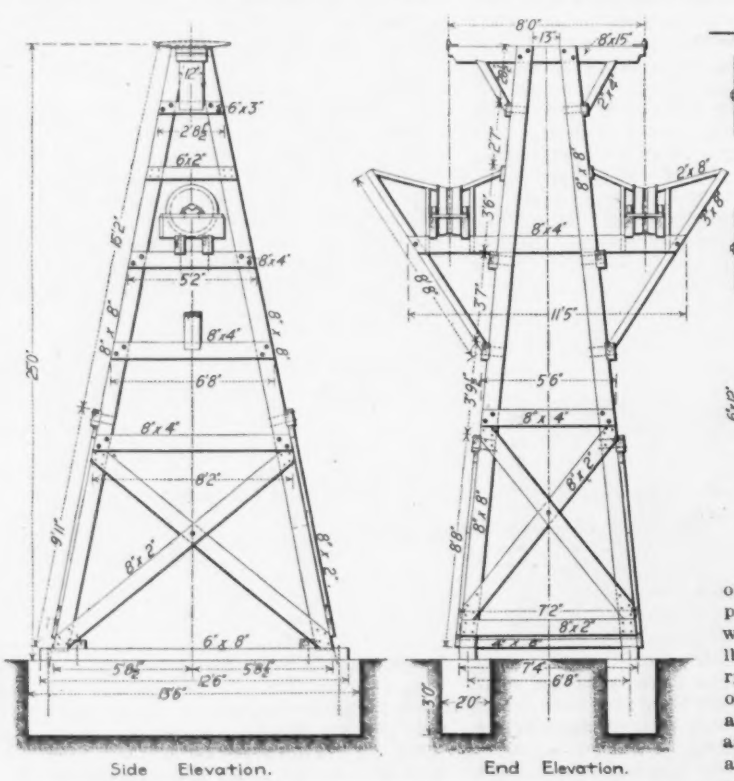


FIG. 4. DETAILS OF 25-FT. TOWER FOR BLEICHERT TRAMWAY.

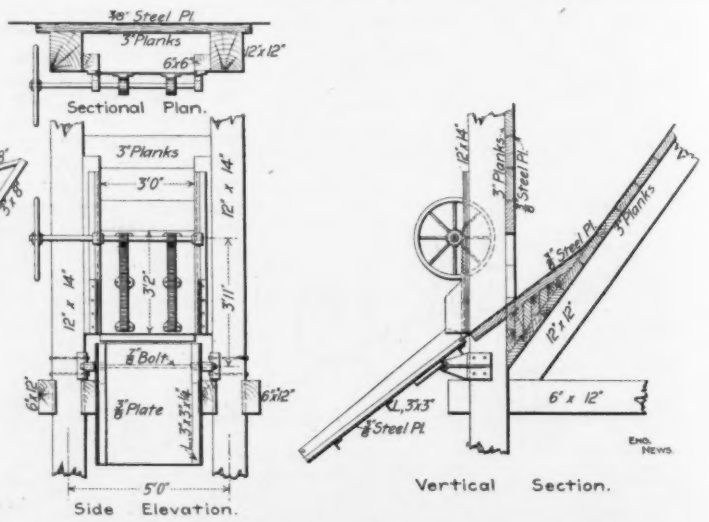


FIG. 7. DETAILS OF ORE BIN GATES AT LOWER TERMINAL.

The pull of the cable on the bull-wheel is opposed by diagonal bracing and also by a cable leading back to a dead-man.

At the discharge terminal each bucket runs on to an unloading track. The grip is released by its handle striking a projecting arm, an attendant causes the load to be dumped, and the bucket runs around on the hanger bar to the position for starting on its return journey.

The traction cable makes the turn around a horizontal sheave mounted on a tension carriage. This slides back and forth, according to the tension of the cable, a chain leading from it over a vertical sheave and down to a weight.

The track cable at the terminal is 35 or 40 ft. above the ground. To raise coal up to its level (for transportation to the mine) the following ingenious method is employed: At the top of the shaft of the cable sheave is a beveled pinion which engages a beveled gear on a short horizontal shaft. The latter shaft is hollow, and it can be keyed to an inside shaft and made to rotate the same. The key fits and slides in a slot cut lengthways of the inner shaft, so that, as the outer shaft and cogs are moved back and forth by varying tension, the outer shaft—sliding on the inner one—is still connected by the key sliding in the slot. The inner shaft has at its further end (about 35 ft. distant) a sprocket wheel and endless chain, by which coal from below is raised up an incline to coal chutes, from which the buckets on the cable can be filled. The power is furnished

the excess of weight on the loaded cable, act- through the 1,000-ft. fall.

To give even wear on the track cable, twice a eek it is gone over and given one-eighth turn at ch tower by means of pipe wrenches. To con- ol its position, a clip or clamp, fastened by a lt and nut, is used, reaching from which is a

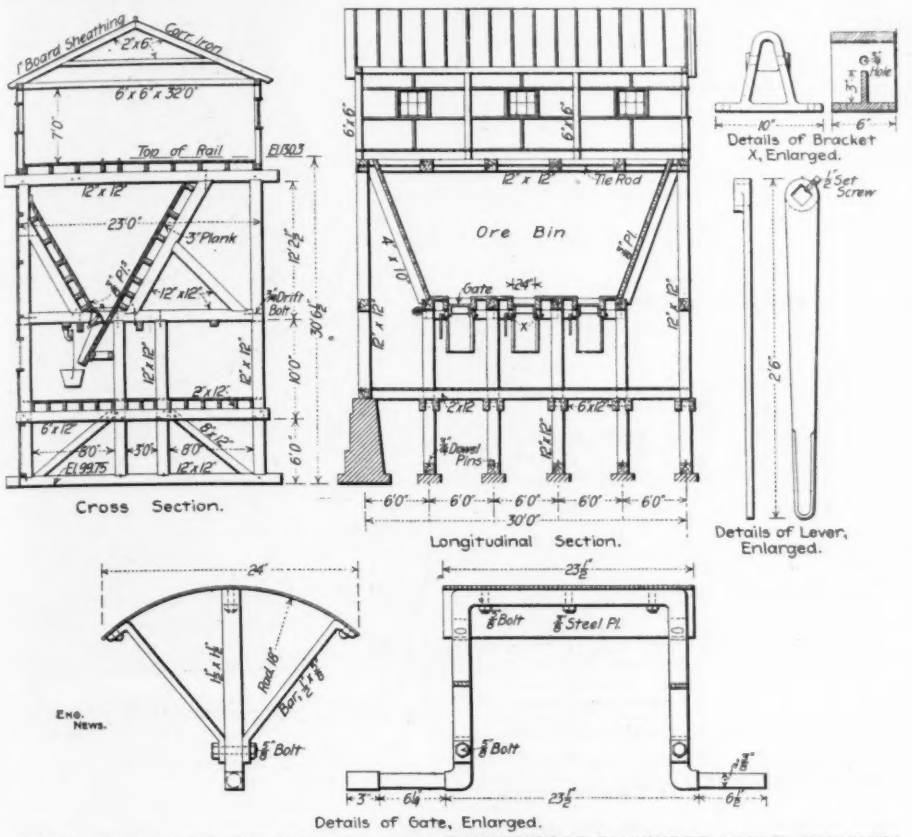


FIG. 5. DETAILS OF ORE BINS AT UPPER TERMINAL OF BLEICHERT CABLE TRAMWAY, HIGHLAND BOY MINE. Geo. K. Fischer, M. E., Chief Engineer.

lever arm whose further end is held between the branches of a double arm that runs longitudinally out from the top of the tower. To oil the traction cable, a bucket is specially fitted up; a spout sticks out in front, being regulated for a certain feed, and this oils the cable in front of the bucket as it moves along. The linemen travel in the buckets at their line work, jumping on and off at the different towers.

The tramway has been in operation about three years. The track cable has been partly renewed during this time. Some parts of the cables have worn out. A splice is made by slipping a sleeve, in shape like a frustum of a cone, over the end of each section and spreading the end. A right and left screw sleeve is then made to connect these, and by screwing up the ends of the cones are brought together.

The cost per ton of ore transported over the line during the latter part of the time has been not over 9 cts. per ton, including all labor and repairs, and this low cost is obtained without credit being given for the coal and other supplies carried over the line to the mine. It is estimated that to build and equip a railroad for economical operation would have cost about four times as much as for the aerial tramway. Figures as to the exact first cost of the tramway complete, with all equipment, are not obtainable, but is it thought to have been about $35,000.

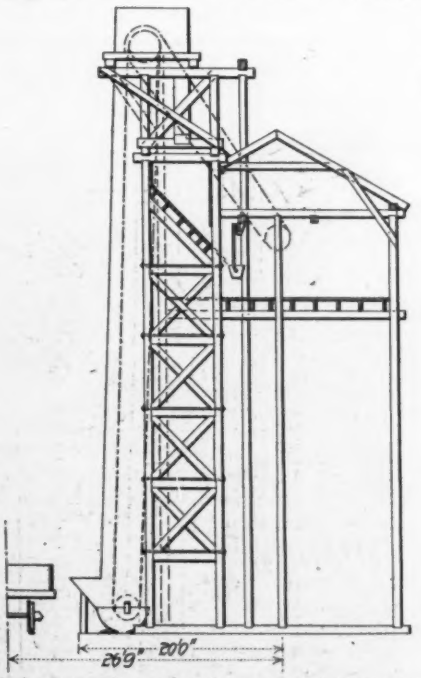
The terminal stations were designed for the company by Geo. K. Fischer, M. E. For the data from which this description has been prepared the writer is indebted to Mr. R. H. Channing, General Manager of the Highland Boy Gold Mining Co., Salt Lake City.

A DOCK SYSTEM AT PORT SAID is being promoted, in anticipation of the great increase in Egyptian crops due to the new barrage works now nearing completion. The shipping facilities at Alexandria—Egypt's only port—are insufficient.

ENGINEERING AND ALLIED FEATURES OF THE PROPOSED CHARTER FOR ATLANTA, GA.

The proposed new charter for the city of Atlanta, Ga., reported on July 1 by a charter committee of 49 members, contains a number of interesting provisions relating to engineering and public works. The charter must be enacted by the legislature before it is effective, and the city council claims the right to amend the draft before it goes to the legislature. Mr. W. G. Cooper is secretary of the charter committee.

The draft provides for nine executive boards,



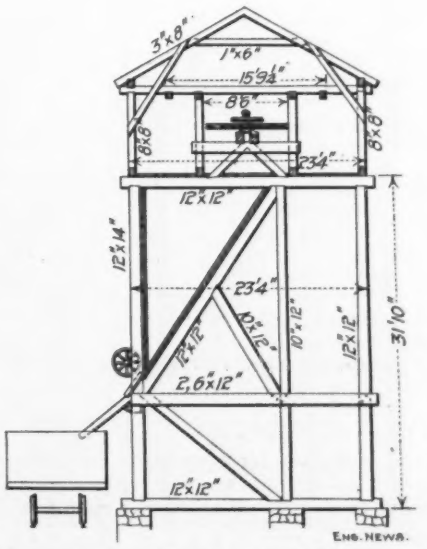


FIG. 6. SECTIONS OF LOWER TERMINAL STATION SHOWING ORE BINS AND COAL HOISTING APPARATUS.

each consisting of the mayor, the chairman of the council committee corresponding to the board, and five (sinking fund, three) members appointed by the mayor and confirmed by a majority of the two branches of the city council voting as one body. These boards are as follows: Water, fire, health, electrical control, parks and forestry, police, education, hospitals, and sinking fund. The chief executive officer of the water board is the superintendent,

> and no person shall be eligible to that position unless he has had at least five years' continual actual practice and experience in the operation of the water-works in a city of not less than 30,000 inhabitants, or is a professional hydraulic, civil or mechanical engineer, holding the diploma of some college, university or technical school of high repute authorized to confer degrees; or has had at least five years' actual practice as a civil or mechanical engineer.

Somewhat similar professional qualifications are required of the city electrician, who is to be the chief executive officer of the board of electrical control. The chief of the fire department must "have had at least three years' experience and active duty in a fire department of a city of at least 30,000 inhabitants.

The city engineer and commissioner of public works are to be elected by the people once in four years, at the same time as the mayor and councilmen. The commissioner must give a bond of $25,000. The paving of streets and sidewalks, and the construction of sewers by contract, falls under the jurisdiction of the city engineer, but all other work on the streets, sidewalks, curbing, bridges, culverts, sewers and drains is controlled by the commissioner of public works "subject to the inspection and approval of the city engineer."

The city engineer has still further and broader duties, including the inspection and supervision of all "public work of whatever nature in the city of Atlanta," whether done "under contract or by way of repairs;" and furthermore it is his duty

> to see that all public work of whatever nature or in any department in the city of Atlanta be so conducted as to prevent waste to the city from lack of co-operation between the departments of the city or from failure to complete work either where two or more departments have charge of the work or otherwise.

Waste of the character just named is to be reported to the mayor by the city engineer, and the mayor "is authorized and empowered by appropriate orders to stop such waste."

The charter reserves for the exclusive use of the city, as against all private companies or individuals, the space beneath the sidewalks on each side of the street, and a space 4 ft. wide, located 4 to 8 ft. from and parallel with the curb, on the north and west sides of all streets. In case this 4-ft. space has already been occupied by private parties the city may claim the same, but must make good any damages thereby which are "well founded in law or fact." These space reservations do not preclude the use by the city of other portions of the subsurface of the street, and private conduits may also be displaced therefrom on settlement of all proper claims.

Assessments for new water mains and hydrants may be made against all owners of improved abutting property who do not take the city water, but the assessments must not exceed $7 each, can

be made but once, and in case the assessed property-owner becomes a water consumer within twelve months of the time the pipes are laid the assessment shall be credited against the regular water rates.

and sunrise. The azimuths are tabulated to the tenth part of a minute of arc, and are adapted for use with the "Nautical Almanac." The price seems to be high for so small a publication, but the data should prove very useful for those engaged in survey work requiring astronomical observations.

per 1,000. These diagrams thus cover the range of ordinary practice, and furnish graphical solutions of this well known formula sufficiently correct for all practical purposes. The ordinary scheme for the values of the "coefficient of roughness" is appended for ready reference.

THE MUNICIPAL YEAR BOOK, 1902.—Giving the Population, Assessed Valuation, Principal Officials,

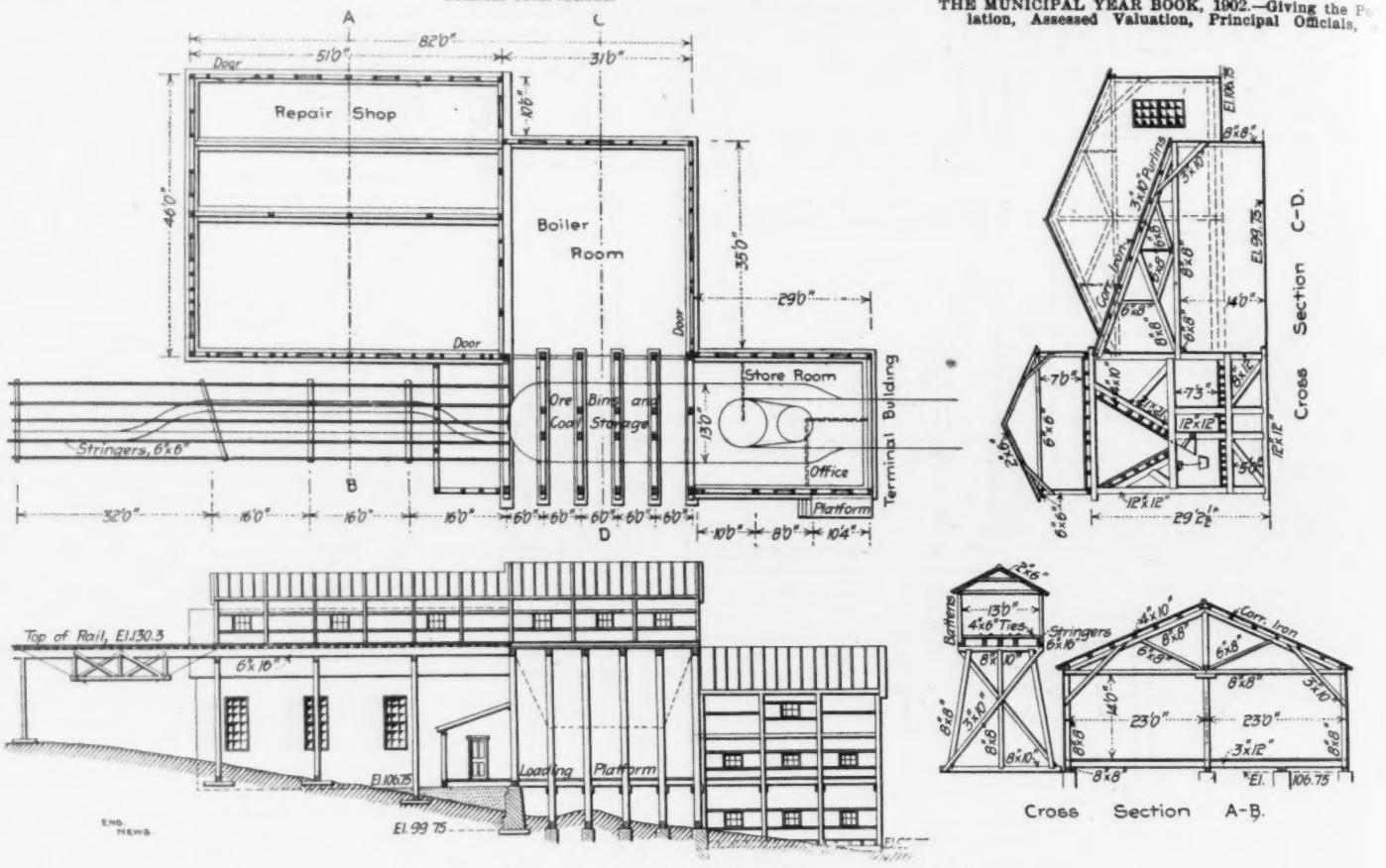


FIG. 8. DETAILS OF UPPER TERMINAL STATION.

The section of the charter dealing with franchises, the secretary of the charter revision committee states, "partakes of features of the New York charter and the San Francisco charter on that subject." The life of new franchises is fixed at 21 years, but grants may, at the option of the city, provide for renewal or renewals, with revaluations of the extension for a term or terms not exceeding 21 years additional. Franchises may provide that the plant of the holder shall become the property of the city at the termination of the franchise, (1) without payment of any kind, or (2), on payment of the "fair valuation of the physical structure." Under (1), municipal ownership without compensation, the city may either operate the plant or lease it to the highest bidder for a term of 30 years. Franchises are to be granted to the highest bidder, after proper advertisement of the conditions and the estimated value of the privileges. Bids are to be based on a percentage of gross receipts and awards are to be made to the "bidder offering the highest percentage or the best attainable terms and conditions for the city," whatever "best attainable," etc., may mean. Charges for public service, methods for valuing property on purchase, and other provisions for protecting the public interests, are included in the proposed charter. The draft, like the San Francisco charter, makes provision for the gradual acquirement by the city of all public utilities. Brief comment on some features of the draft are made on our editorial pages.

BOOK REVIEWS.

AZIMUTHS OF THE NORTH POLE STAR, Latitude 38° N. to Latitude 55° N. for Use until the Year 1915. By Sydney A. Roberts, D. & P. L. S. Paper; 8 × 11 ins.; pp. 12. Price, $2. Address the Author, Victoria, British Columbia.

This pamphlet consists of tables giving the azimuth of Polaris for each degree of latitude within the limits above stated for a fixed polar distance of 1° 11′ 40″; and tables to correct this polar distance for any hour angle. The object of the book is to permit the observer to find a meridian by observation on Polaris at any time between sunset

DIAGRAMS OF UNIFORM MOTION OF WATER IN OPEN CHANNELS: Based on the Formula of Ganguillet and Kutter. Prepared by Irving P. Church, C. E., Professor of Applied Mechanics and Hydraulics, College of Civil Engineering, Cornell University. New York: John Wiley & Sons; 12½ × 9½ ins.; 11 diagrams and explanation of the same. $1.50.

These diagrams are made out for values of n, ranging from .009 to .035, and 0.10 to 25 for the value of the hydraulic radius; the slope used varies from 0.01 to 100

Ownership of Public Utilities; also information regarding the Water Supply, Sewerage, Street Cleaning, Street Sprinkling, Garbage, Fire and Underground Electric Service in all Incorporated Places in the United States, and in all New England Towns of 3,000 Population and Upwards by the Census of 1900. With Summaries and Editorial Discussion. Edited by M. N. Baker, Ph. B., C. E., Associate Editor of Engineering News. New York: The Engineering News Publishing Co. Cloth; 6½ × 9 ins.; pp. LIV., 310; 18 tables. $3.

In accordance with the custom of this journal when

FIG. 9. GENERAL VIEW OF BINGHAM, UTAH.

ing its own publications, we confine ourselves to a tion from the preface to the book now before us:

book combines a directory of municipal officials and ise companies, an exhibit of municipal and private ship, and an outline of the leading public works and es in each of the 1,524 largest municipalities of the y. It includes all incorporated places of 3,000 and ds by the U. S. Census of 1900, and in addition all England "towns" of like size. The facts of most vital interest under each municipality are summarized and commented upon in the introduction, which includes a detailed review of the present status of such important facilities as water and sewage purification, improved means of garbage disposal, public baths, underground wires and central heating stations, and of municipal and private ownership.

Never before has there been presented so complete an exhibit of the relative extent of municipal and private ownership. This information is first given alphabetically by states, together with the other facts relating to the various cities and towns. It is next presented alone, in compact tabular form, with the cities arranged in order of population, from Greater New York, with 3,437,202, to Rice Lake, Wis., with 3,002 inhabitants. Various summaries, by geographical location and by population follow.

This list of cities will be of service to engineers and city officials who wish to make comparative studies of places of the same general size. Other convenient lists, accompanying the reviews already named, give the cities having water and sewage purification plants, garbage cremation and reduction works, private sewerage companies, and municipal gas plants, and which have had to defend water pollution suits.

In the body of the book there is given for each city and town its population by the census of 1900, its assessed valuation in 1901 (unless otherwise stated), its principal officials, and what is owned by the municipality and by private companies, respectively, with the names of the latter. Water supply, sewerage, water pollution, street cleaning, street sprinkling, garbage collection and disposal, the fire department, and finally, the location of electric wires, whether overhead or underground, receive attention in the order named. Whether the day-labor or the contract system of street cleaning and sprinkling, and whether the cost of each service was met by the city or by the owners of the property benefited, are also given.

It will be noticed that the heading "City Owns" is sometimes followed by the words, "Nothing covered by inquiries (see Preface)." The subjects covered were: Waterworks, sewers, electric lights, parks, play-grounds, public baths, gymnasiums, markets, cemeteries, fire and police alarm telegraphs, gas works, ferries, docks and wharves.

Likewise, "Companies Own" was designed to include: Water-works, gas works, electric lights, street railways, telephones, bridges, ferries, sewers, and central heating stations.

This book is based on special returns made, with a very few exceptions, by the city officials of the several places included. The interest taken in the project is partly indicated by the fact that formal reports were secured from all but five or six of the 1,524 cities and towns included. The official returns have been supplemented by special information, collected for a number of years past by the editor and publishers, on water-works, sewerage, water and sewage purification, garbage disposal and municipal ownership. In addition, it is a pleasure to acknowledge that the reports have been checked, and in some instances supplemented, by reference to the following publications: For assessed valuations, "State and City Supplement of the Commercial and Financial Chronicle;" for fire protection, "Hand-Book of Water-Works Statistics and Fire Department Equipment," published by Shepperd & Burnham; for municipal and private ownership, Powers' "Central Station Directory" and "Street Railway Directory," Poor's "Manual of Railroads," the "Street Railway Supplement of the Commercial and Financial Chronicle," and Brown's "Directory of American Gas Works." For everything pertaining to public water supplies free use has been made of "The Manual of American Water-Works."

After the returns for "The Municipal Year Book" had been revised and extended, as indicated, typewritten copies were sent to the officials who made the original reports. Nearly all these officials returned the copies thus sent with their final revision or certificate of correctness. In this manner greater accuracy and completeness were secured, and coincidently the information was brought up to a later date.

PERMANENT MOLDS FOR IRON CASTINGS form the basis of the International Foundry Co., chartered at Trenton, N. J., on July 16, with $5,000,000 capital. Charles Szekely, of New York, is credited with having invented a process for smearing the inside of sand molds with some secret preparation which obviates the necessity for breaking the molds after each casting.

FIG. 10. VIEW AT UPPER TERMINAL OF BLEICHERT CABLE TRAMWAY.

COMMERCE BETWEEN THE UNITED STATES and its newly-acquired territory is noted as follows by the U. S. Bureau of Statistics: In 1897 the shipments to Porto Rico, Hawaii and the Philippines aggregated $6,773,560; in 1901 they amounted to $30,000,000, and in the fiscal year ending June 30, 1902, they were fully $35,000,000. If to this we add the estimated $15,000,000 for Alaska, the total sales of American goods to the non-contiguous territory of the United States amount to $50,000,000 in 1902, against $10,000,000 to the same regions in 1897.

THE INDUSTRIAL ELECTROLYSIS OF WATER for the purpose of obtaining pure oxygen or hydrogen gas is described by Mr. Engelhardt in the "Zeitschrift des Oest. Ingenieur-Vereines" for May 9. The author discusses the process from a historical and theoretical point of view, and describes eight electrical processes for producing these gases industrially. By the Schmidt system 100 cu. m. of gas can be made per day with 10% loss. The cost of producing a cubic meter of hydrogen or oxygen gas varies from 37 to 58 centimes, according to the use of hydraulic power or steam as a prime motor. Other methods of producing these gases are also discussed.

ELECTRICALLY-CARBONIZED PEAT FUEL is the subject of a patent issued to P. Jebsen, of Dale, Norway. The process has been in actual operation since 1898 at Stangfiorden, Norway, and the plant there handles 1,000 centners of air-dried peat per day. An electric current is used in specially designed retorts for carbonizing the dried peat, and the product is a dense and compact fuel of about .30 specific gravity, having a theoretical calorific value of 7,250 thermal units. It burns well and yields little ash or soot. The wet peat is run through a press, then passes on wagons through a drying tunnel heated by waste gases to 90 to 100° C., and it finally passes to the retort, which is lined with asbestos. The latter has spiral resistance coils of peculiar design and the peat briquettes are built up in actual contact with these until the retort is full; the top cover is now clamped down and the electric current is turned on. The peat yields for each 100 kg. of air-dried peat 23% of gaseous products which pass to the drying tunnels, 33% of peat fuel, 4% of peat tar, and 40% of tar water. The cost of the process is not given.

THE LITHOGRAPHIC STONE DEPOSITS OF EASTern Kentucky are described by Mr. E. O. Ulrich, of the U. S. Geological Survey. The presence of this stone was known 30 years ago, but nothing has been done until lately to develop the deposit. The only stone proven to be at all satisfactory for lithographic purposes found in the United States lies on the Licking River near the junction of the counties of Rowan, Bath and Menifee, near the new town of Yale. The only good deposit here furnishes a gray and blue lithographic stone that has been satisfactorily tested in the lithographic department of the U. S. Geological Survey at Washington. Other deposits of very good yellow lithographic stone are found nearby, but the stone is so fractured that it is doubtless if pieces 2 ft. square could be secured. The deposit of gray and blue stone is being developed by a company of citizens of Mount Sterling and Louisville, and Mr. Ulrich expresses his belief that the enterprise will be successful and a paying venture. The imported Bavarian lithographic stone costs from 20 cts. to $1 per pound, according to size.

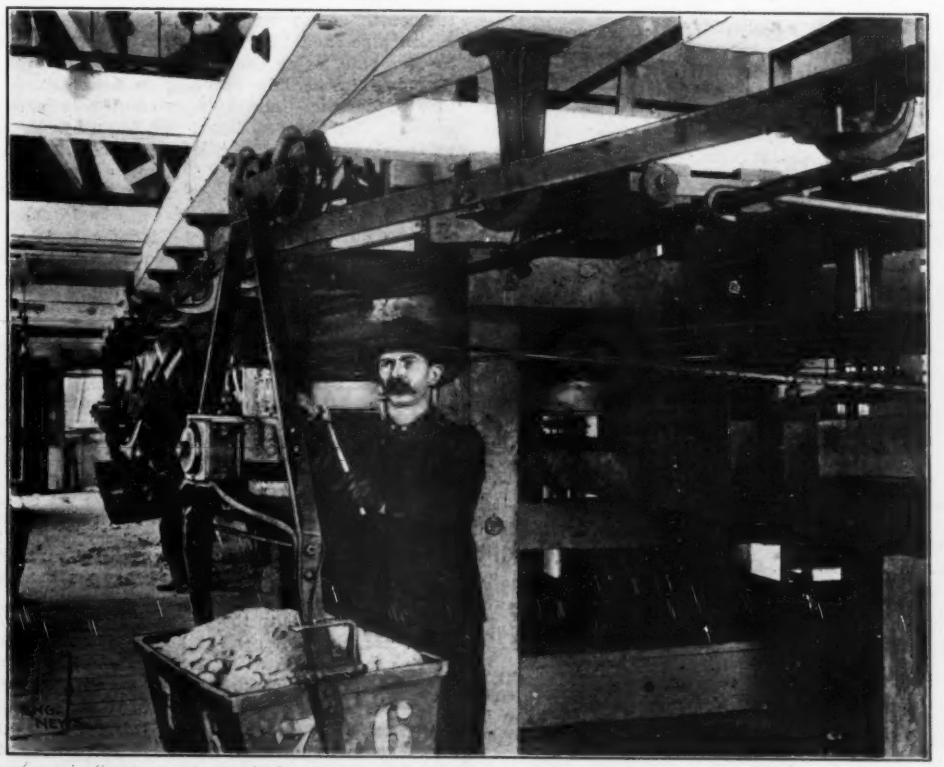


FIG. 11. INTERIOR OF STATION AT UPPER TERMINUS.

(Bucket on hanger arm ready to be pushed forward and gripped to traction cable.)

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Entered at the New York Post-Office as Second-Class Matter.
Published every Thursday
at St. Paul Building, 220 Broadway, New York, by
THE ENGINEERING NEWS PUBLISHING COMPANY

GEO. H. FROST, - - - - - - - - - PRESIDENT.
D. MCN. STAUFFER, - - - - - - - VICE-PRESIDENT.
CHARLES WHITING BAKER, SECRETARY AND MANAGING EDITOR.
F. P. BURT, - - - TREASURER AND BUSINESS MANAGER.

WM. KENT, E. E. R. TRATMAN, M. N. BAKER, CHAS. S. HILL, } ASSOCIATE EDITORS.

A. B. GILBERT, - - - - - - - ASSISTANT MANAGER.

CHAS. W. REINHARDT, - - - - - CHIEF DRAFTSMAN.

ALFRED E. KORNFELD, New York,
M. C. ROBBINS, Chicago,
S. B. READ, Boston. } ADVERTISING REPRESENTATIVES.

PUBLICATION OFFICE, 220 BROADWAY, NEW YORK.
CHICAGO OFFICE, 1636 MONADNOCK BLOCK.
BOSTON OFFICE, 170 SUMMER ST.
CLEVELAND OFFICE, OSBORN BUILDING.

FOREIGN AGENTS.

C. MITCHELL & Co, Snow Hill, Holborn Viaduct, LONDON.
RUDOLF MOSSE, BERLIN and HAMBURG, GERMANY.
JOHN F. JONES, & CIE. 31 Rue de Faubourg Montmartre, PARIS.

SUBSCRIPTION RATES: United States, Canada and Mexico, One Year, $5.00; *6 months,* $2.50; *2 months,* $1.00. *To all other countries in the Postal Union: Regular Edition, One Year,* $7.00 (31 *shillings*); *Thin Paper Edition, One Year,* $6.31 (26 *shillings*). *SINGLE COPIES of any number in current Volume,* 15 *cents.*

In requesting change of mailing address, state BOTH old and new address; notice of change should reach us by Tuesday to be effective for the issue of the current week. The number on the address label of each paper indicates when subscription expires, the last figure indicating the year and the one or two preceding figures the week of that year; for instance, the number 322 means that subscription is paid to the 32d week (that is the issue of Aug. 7) of the year 1902; the change of these figures is the only receipt, unless one is sent by special request.

ADVERTISING RATES: 20 cents a line. "Want" and "For Sale" notices, special rates, see page XXIV-XXIX. New copy for standing advertisements should be received one week in advance of publication; new advertisements, Monday morning. The pages containing "Want," "For Sale" and "Proposal" advertisements are held open until Wednesday noon.

The proposed new charter for the city of Atlanta, some portions of which are abstracted elsewhere in this issue, contains many features that will meet the approval of engineers. But it is not plain why the city engineer should be elected by popular vote instead of being appointed by the mayor, and his appointment confirmed by the council, and it seems strange that nothing should be said regarding his qualifications, particularly when the charter is so specific on the qualifications of the superintendent of water-works and city electrician. It may be, however, that some of the unamended sections of the old charter, not printed in the report of the charter revision committee, cover this point.

Work along eminently practical lines is becoming more and more common in the various government departments centering at Washington. Thus, the department of agriculture, under the agricultural bill passed by the last Congress, is to investigate the subject of drainage. This work falls under the general direction of Mr. Elwood Mead, M. Am. Soc. C. E., Chief of Irrigation Investigations, but will be in the immediate charge of Mr. C. G. Elliott, M. Am. Soc. C. E., of Indianapolis, Ind., and editor of the "Drainage Journal." Plans are now being prepared for removing surplus water in the Fresno district, California, and for draining some over-irrigated areas in Colorado. Other sections, outside the irrigated area, will also receive attention. The work will be watched with interest.

The fall of the historic Campanile at Venice has prompted the Boston "Transcript" to tell editorially "How a Tower Falls." According to our contemporary the manner of it is thus:

> What engineers call the theory of continued strains doubtless explains the fall of the Campanile. The character of the soil of Venice is such that when a heavy structure is erected at any place, there becomes a greater pressure set up where the substratum is thinner than in other places, and this pressure in time becomes a cumulative force, just as a slowly moving body gathers momentum. Such accumulated pressure of a tower 100 ft. higher than Bunker Hill Monument, gathered through hundreds of years, must obviously become irresistible.
>
> Then, too, the disintegrating influences of winds, rain, heat and cold alternated, freezing and thawing, contributed to the fall. Fortunately warning was given by the crack which appeared in the tower, but the appearance of this crack should have told the Venetian engineers that in such a structure this apparent weakening indicated the end very near. It is interesting to note that the tower of the new Old South Church in Boston bears a close resemblance, in respect to its engineering, to the famous Campanile, and many alarms have been sent up about it. Perhaps the course of time will bring about the same result in that structure—in a thousand years more or less. But it is examined carefully every now and then, and no sign of any need for warning is found.
>
> The possibility that the recent disturbances in the interior of the earth had anything to do with the fall of the Campanile is too remote to be considered. Yet there are slow movements taking place in the earth's surface all the time, extending through hundreds of years, and it is possible that these, to which the Mediterranean region is especially susceptible, might have hastened the inevitable catastrophe.

We suspect that some jocose Massachusetts Institute of Technology student must have written this as a "gag" on the "Transcript" editor. There are wags who are capable of doing such things. It is rather too bad, however, to so impose upon a serious journal, for there may be some of its readers who also receive a quip solemnly. Moreover, Old South Church is threatened, and this is little short of *lese majeste.*

Agitation against the introduction of water meters at Memphis, Tenn., is being conducted in a ridiculous manner by the "Scimitar" of that city. In an editorial in its issue of July 4 that journal said, or, as the opening words indicated, repeated, the following:

> As the "Scimitar" has said time and again, the meter would put the ratepayers of the city absolutely at the mercy of the water company, and those who have had differences with that corporation need not be told how little chance the ratepayer has in any such dispute. The citizen would have to pay the bill presented, though it might exceed the rental of the property in question, if he was the owner, or the amount of his earnings if he was a renter and a wageworker. If a concealed pipe should leak (and many of such do leak) the consumer would have to pay for "waste," though he would have no means of discovering the leak, nor any just responsibility for the condition of the pipe, and the president of the water company has admitted that such "'waste" might cause a frightful increase in the consumer's water bill.

Why, in the name of common sense, should not the consumer pay for the "waste" in case "a concealed pipe should leak?" Is the water company in Memphis, or is the city of Nashville, where municipal ownership prevails, to bear the penalty of defective plumbing, concealed or unconcealed? Certainly it should not, except in so far as the company, or the city, is responsible for the plumbing.

The following day the "Scimitar," in an editorial headed "The Meter as a Blood-Sucker," brought out what it termed "documentary" evidence against water meters, bearing "the imprint and signature of the water company itself." It said:

> The account rendered on July 1 to Mrs. E. Levi, which was printed in yesterday's "Scimitar," is a fair specimen of the work of the water company's little mechanical arithmetician. Other bills of like character have been produced by ratepayers and published in the daily papers.
>
> Mrs. Levi is the owner of a small double tenement from which she gets a rent of $14 a month. Her water bill for the month of June was $12.45, but the water company, after some discussion of the account, deducted $2.45 for "leaks," to "help her stand the loss." The net charge for water assessed against Mrs. Levi was therefore $10, leaving her $4 for the interest on the money invested in the property, repairs, taxes and other charges. At this rate it would be better for her to deed the property to the water company and be done with it.

Did it ever occur to the editor of the "Scimitar" that occupants of tenement houses sometimes let water run to waste without let or hindrance, and that owners of such property have been known to neglect to keep the plumbing in repair? After remarking that if meters were introduced property-owners would have to "either raise the rent or put the water bill on the renter," the newspaper in question says:

> Rents in this city are about as high as people can pay and have enough left to settle with the butcher and grocer.

This is doubtless true, and so, as a matter of economy and convenience to renters, why not include the bills of the butcher and the grocer and the milkman as well, in the house rent? Of course, the rent would have to be raised, but all families in a given kind of houses and locality would then have uniform bills without any concern as to the quantity of their food, how much bread and meat they put into the garbage can, and how much milk they turned down the sink. The time is bound to come when the following of selling water at a fixed price per year, regardless of the amount used and wasted, will be no more tolerated than a like plan for providing families with groceries, meat and milk, and when the person who uses or wastes the water will be held responsible therefor, and not his next-door neighbor or his landlord.

THE CENSUS BULLETIN ON THE UTILIZATION OF WASTES AND BY-PRODUCTS

In an editorial which appeared in Engineering News some eighteen months ago attention was called to the enormously heavy drafts which had been made upon nature's stores by the industrial development of the last two generations. A contrasting picture to the extravagant consumption of natural wealth with which we then somewhat boldly tasked mankind is afforded by the advance which the engineer and chemist have made in utilizing those products that were once rejected as wastes or residues in the operations of manufacturing establishments. Interesting evidence of the extent to which such wastes and residues are utilized is furnished by a recent bulletin issued by the United States Census Bureau. This bulletin is in substance a monograph on the subject written by Mr. Henry C. Kittredge, of Boston, Mass. Briefly explained, this monograph gives an account of the wastes and by-products resulting from a number of familiar manufacturing processes and of the useful substances which are or can be made from them.

The length of Mr. Kittredge's paper, some 24 large folio pages, makes it impossible to review it in detail here. It seems desirable, however, to consider some of its features briefly, more particularly because it seems to us that the method of treatment and many of the statements made deserve criticism. Errors and misleading assertions have been inadvertently allowed to creep in in several places, and are likely to cause misunderstanding if they are not corrected. It should be explained at the outset, however, that a near approach to universal knowledge of the technology of manufacturing processes would be required to review critically all of the subjects handled in the bulletin. We shall, therefore, refer only to those with which we are somewhat familiar.

One of the first examples of waste utilization which the writer of the bulletin instances is the utilization of city refuse and garbage. To engineers it will appear, we think, that this important subject is rather inadequately discussed even within the limits of the space allotted to it. The account given fails first to impress upon the reader the decided difference between the two classes of waste named, and, consequently, the very great difference between the methods of disposing of or utilizing them. Referring, first, to city refuse, by which term we take it that the author means such wastes as ashes and sweepings from streets, shops and houses, we note the statement that "formerly this refuse was simply accumulated and disposed of by burning or casting into streams or onto waste land," while now "bones, glass, rags, iron, paper and other articles are separately collected and sold." The logical conclusion from these statements must be that there has been a radical change from the general waste to the general utilization of city refuse between formerly and now. The facts are, that the separate collection of the articles mentioned is but little more common now than formerly, and is so far as it exists, a part of the junk trade rather than of any systematic effort on the part of the city administration. In regard to the use of waste heat from refuse furnaces it would have been more valuable if the author of the bulletin had stated that this practice was followed in a number of European cities, but practically nowhere in the United States, instead of merely instancing the city of Glasgow and giving a rather doubtful

figu[illegible] of the horse-power generated by the waste heat [illegible]om that city's refuse furnaces.

T[illegible]ng up the subject of garbage utilization nex[illegible]he bulletin remarks that the "food wastes of [illegible]w York city are disposed of by what is kn[illegible] as the Arnold utilization process," and describ[illegible] this process in outline. No hint is given an[illegible]ere that garbage utilization is practiced by an[illegible]ther city, either in this country or abroad, or [illegible]t other methods of reduction than the Arnold [illegible]re available. This statement, as every engi[illegible] knows, conveys the merest fragment of kn[illegible]edge as to the actual status of garbage utilization. To illustrate this fact we may point out fi[illegible]that there are 22 cities in the United States w[illegible]h have garbage reduction plants, and whose fo[illegible] wastes are collected and reduced to useful p[illegible]ucts in most cases on fully as systematic p[illegible]ns as are the similar wastes of New York city. E[illegible]en when this information is substituted for the statement made in the bulletin, the fact is notorious that only an exceeding small percentage of American cities reduce their food wastes to useful products. Of 1,524 cities of over 3,000 population in the United States only 22 have garbage reduction plants, according to statistics collected for the Municipal Year Book of 1902. A further fact which is worth noting is that few if any of these reduction plants are self-supporting in so far at least as being no burden of expense to the city. They are without exception operated by private capital and receive a money bonus from the city, besides whatever profits may accrue from the sale of the products of reduction.

Enough has been said, perhaps, to demonstrate that the author of the census bulletin before us has given a very inadequate idea of the subject of city refuse and garbage utilization. The next example of waste utilization cited by the bulletin is that furnished by the iron and steel industry. Referring to the possible utilization of blast furnace slag the bulletin quotes from a paper read in 1872 before the American Institute of Mining Engineers, in which is described "a process by which, at small cost, good bricks may be made of it, and a cement equal to the best Portland cement." A good many things have happened in the cement industry since 1872, and there will be very few engineers to-day, we imagine, who can be made to believe that any slag cement is equal to the best Portland cement. Indeed, the statement quoted is so far from being a fact that another government bureau, the U. S. Engineer Corps, has felt compelled recently to express itself vigorously upon the inferiority of slag cement, and to criticise severely those manufacturers who implied by their trade nomenclature that a slag cement was in any sense a cement of similar or corresponding quality to a Portland cement.

Continuing the subject of cement manufacture from slag, the bulletin refers to the existence of two slag cement plants near Birmingham, Ala. In passing it may be noted that the author quotes here from an article contributed by Mr. Edwin C. Eckel to Engineering News, and erroneously credits the quotation to the Transactions of the American Society of Civil Engineers. Passing on the bulletin gives figures showing that in 1892 there were ten slag cement factories in Germany, and quotes from a paper by Mr. R. W. Mahon, read before the Franklin Institute in 1893, which recorded experiments answering "the question affirmatively whether it was possible to make from slag a cement." These are all statements of fact, although somewhat ancient information, and our only criticism is that they require amplification to give an accurate indication of the limitations and importance of the slag cement industry.

Some ten or fifteen years ago the manufacture of slag cement was much exploited abroad, and particularly in Germany. Since that time it has been largely lost sight of in the interest attracted by the enormously more important development of the Portland cement industry. No slag cement plants have recently been built in Germany, while a number have been abandoned. The reason for this is the very simple one that the slag cement cannot compete commercially with Portland cement. Not all slags can be used for making cement; only basic slags are available, and they must approach a certain chemical composition. There are so far as we know six slag cement plants in the United States, and during the year ending June 30, 1901, they produced 272,689 barrels of slag cement. The total production of hydraulic cement of all kinds during the same year was 20,068,737 barrels. It may be stated incidentally that the bulletin makes no reference to the use of slag as an ingredient in Portland cement manufacture. There are two plants in the United States that utilize blast furnace slag in this manner, which, it should be noted, is distinctly different from the manner in which it is used in making slag cement, and there are a number of similar plants in Belgium and Germany. We have not made these comments because we have any quarrel with slag cement; it has its place among hydraulic cements, and that place is generally well known to engineers; but because they are necessary to a correct understanding of the limitations and importance of blast furnace slag as a material for cement manufacture.

Continuing on the subject of slag utilization in connection with the cement industry, the bulletins says:

> It has been found that a mixture of prepared slag with cement adds to its tensile strength in the end, but is apt to have the effect of slightly lowering the initial strength of the cement, i.e., the resistance to tension and compression which the cement acquires within, say, from one to seven days. This defect, however, says A. D. Elbers, in the "Engineering and Mining Journal," of 1897, can be overcome by treating the prepared slag with an aqueous solution of sodium carbonate, rendering it so efficient that a suitable admixture of it with Portland cement is apt to raise the tensile strength of the latter from 50 to 100 lbs. per square inch.

We do not have Mr. Elbers' paper at hand, and cannot say how accurately he has been quoted, but engineers generally at the present time regard the addition of ground slag to Portland cement simply and solely as a particularly vicious method of adulteration.

We have, perhaps, proceeded as far with these itemized criticisms as the importance of the subject to our readers warrants us in going. Considering the bulletin as a whole, the utter lack of statistical information is, it seems to us, deserving of criticism. We fully realize, we think, that it is impossible to measure statistically the entire quantity and value of the useful substances and articles which are produced from the wastes and residues of manufacturing processes, but it is not plain to us why some of these articles and substances could not have been so measured. It is possible that these statistics are given in other bulletins and that it was not thought necessary to repeat them here. To have done so, however, would have taken no great amount of space, and the collected figures would have been of much value. Without some form of summary the reader who is otherwise uninformed is left entirely in the dark whether any particular waste or residue is utilized on a large or a small scale, or, in other words, whether it is a commercial process or merely a scientific possibility. The mere fact that a certain waste or by-product can be turned into certain useful articles or substances is of course of interest, but it is more interesting to know whether or not this conversion is carried out on a commercial scale. The latter information is, as a rule, omitted by the author of the bulletin.

In conclusion, it may be noted that the bulletin is by no means exhaustive in cataloguing even the more familiar examples of waste utilization, and that on the other hand it includes as examples of waste utilization certain products which hardly deserve that designation. We find no mention, for example, of the conversion of the gases of retort coke ovens into tar, ammonia and other substances. No mention is made of the by-products of gas manufacture, nor do we find any account of briquette fuel manufacture from coal dust and coke breeze. On the contrary, we have the manufacture of wood pulp for paper-making and of powdered milk classed as examples of waste utilization. The mention of these items may savor somewhat of captious criticism, perhaps, but the subject which the bulletin treats is of such importance that it will do no harm to be to some degree hypercritical in our comment. Altogether the bulletin, despite its faults, will be suggestive and instructive to any one who reads it intelligently, and the officials of the Census Bureau are to be commended for having prepared and published it.

LETTERS TO THE EDITOR.

Telephone Tunnels and Street Railway Subways in Chicago.

Sir: I have read the article in the last issue of your valuable paper on the "Telephone Tunnels and Street Railway Subways in Chicago," and noted the illustration showing a section of a proposed subway prepared by me in 1900. I wish to state in connection therewith that the plans prepared by me were not intended as final and complete in any way, but were intended merely as a suggestion. There were some preliminary plans prepared by Mr. John M. Roach, President of the Union Traction Co. of Chicago, and by Mr. W. S. McHarg, Engineer in the Intercepting Sewer Division of the city, both of which plans, in my opinion, had several very objectionable features, and my plans were prepared solely with a view of suggesting something that might be done.

Yours very truly, John Ericson, City Engineer.

Chicago, Ill., July 18, 1902.

The Percentage of Voids in Sand.

Sir: In Engineering News of July 10, "Civil Engineer" springs a problem on the percentage of voids in sand; gives two answers, and is in doubt which is the correct one. If his box held 1 cu. ft. of loose, shaken or compacted sand and thereafter it required 0.342 cu. ft. of water to fill the box or that much water was taken up by the voids in the sand, then, evidently, the percentage of cubical voids in the sand is 34.2. This amount of voids of course varies with the mechanical way in which the sand is settled in the box, also with the various kinds of sand, whether fine or coarse, free from loam, etc., but these have nothing to do as to the manner in which the voids are estimated. Suppose the box were filled with shot and shaken down until level full, then a small amount of water poured in and the shot reshaken, would the shot settle materially as the sand did? I think not. But you continue to fill the box with water and it takes 0.342 cu. ft. to fill it. Would this not make the voids in the shot 34.2% of the cubic foot? There are two material substances filling the box, to-wit, sand and water, and the cubic space not filled by the sand is filled by the water and that space is 0.342 cu. ft. and is the measure of voids contafned in the sand, however much these voids may vary as to the mechanical mixture in other tests.

Very respectfully, W. F. Mann.

Kokomo, Ind., July 12, 1902.

The Longevity of Timber—Experience with Sand-Binding Vegetation.

Sir: Noticing items in recent issues concerning the longevity of oak timber, I wish to add the following to the subject: It is not uncommon to find in the woods of Oregon large trees growing with their roots across the trunks of fallen trees. I have noted trees so growing of a size which would require at least 100 years' growth. The fallen timber is of the pine nature and very similar to what is locally called "old growth" fir. It has remained sound and retains, apparently, all of its original strength. Compared with the new growth of fir it is soft and entirely free from all pitch seams and minor defects. Generally the tops of the trees are entirely gone; and the bark and sap wood turned to vegetable mold, which, with a covering of moss and small shrubs, forms a condition generally supposed to be conducive to decay. However, it would not do to require a stick of fir timber in an engineering structure to retain its properties for a like period. There are many contradictions in nature.

I also add the following to the several notes appearing in your journal concerning sand-binding vegetation. The information is from observations of the results obtained by the U. S. Engineer Department at Coos Bay, Oregon. The first Holland or Marram grass planted was obtained from Golden Gate Park, San Francisco, Cal. It was planted in hills, about 18 ins. apart, the roots being placed in holes in the sand. The area covered was on a flat plain of sand exposed to the full force of the winter gales from the south, and protracted drying, northwest, winds in summer. It was planted in 1891 and is now growing out of the tops of hills 20 ft. high, built by sand collecting around the grass. It does not spread fast from the seed and is of comparatively slow growth; but once fairly started it seems to be very tenacious. Cattle will not forage on it. It does not lose its verdure or sand-collecting qualities in the winter, as the majority of the native sand plants of this locality do. It will grow in unadulterated sea sand. Sea Lyme is a native sand grass, but it is not evergreen. It grows well from seed; cattle will eat it with relish, and it is good forage, being very nutritious. In this locality it thrives only in soil containing decaying wood, etc., and is found most abundant close to the beaches, where it is supported by the decaying flotsam. There are numerous varieties of plants growing on the sand at this locality; but they generally lose their verdure during the winter, and require more or less nourishment from decaying wood, etc., in the sand. Very respectfully, T.

Empire City, Ore., July 3, 1902.

The Length of the Vara.

Sir: I see by your paper of July 3, et ante, that the question of land measurement in Texas is under discussion, and I will beg leave to add my quota to the information. I can speak with some authority, being a civil engineer and also having been compiling draftsman of the General Land Office of the State of Texas, and for years one of the bonded deputy district surveyors, though at present I do very little field work.

I had the good fortune to meet at Beaumont a Mr. Bullock. I believe he was from Washington. As to his qualifications as a civil engineer I do not know, never having seen any of his work, but as to his qualifications as a surveyor of Texas lands he was in the same condition as the "man who went down into the sea in ships." This was not Mr. Bullock's fault, and under ordinary conditions undoubtedly he would have made a good showing, but the trouble in Texas is not a question as to the certainty of the unit of measurement. You have to take into consideration the conditions under which the surveys of the original grants were made by the Spanish government.

The land was of small value, hostile Indians were in the country, and the work, when it was done on the ground, was very hastily and very carelessly done, and the thing that is most surprising is the fact that it was as well done as it was. In regard to the unit of measurement, or the vara, the length of the vara was fixed by the legislature at 33⅓ ins., but it does not follow that any particular survey in question was made with a vara of that length.

The early surveyors used the vara of Castile, Leon and Aragon, all of which differed in lengths. They do not state in the field notes what vara they used, and sometimes they do not state what variation of the needle was used, and in many instances the surveys were run magnetic. It has even been charged that surveys have been made by the Mexican surveyors taking a course, lighting a cigarette, and when the cigarette had burned out, calling the distance traveled one mile. Now, we have no means of arriving at the approximate estimate of the length of "one smoke." It takes something more than a trained engineer to re-establish these old lines; he must know the habits and customs of the country; he must be to some extent learned in woodcraft; he must be able at least to judge of the timber marks, as to their approximate age, and he must be able to follow, if possible, the original lines as laid down by the original surveyor. This is sometimes the most difficult thing to do. Then he must measure from corner to corner, and he will seldom find that the distance given by our accurate instruments in use at present will correspond with the distance given in the original field notes. He must accept this as he finds it.

You must understand that there has never been any regular work done; that all the surveying of the state has been done pretty much after the manner of the old states, and that these grants were given to a man, or, in other words, the certificate was given to a man entitling him to have surveyed for himself so many acres of the public domain. This he turned over to a district surveyor, who surveyed a piece of this public domain and returned the field notes to the General Land Office.

It is not surprising under this system that the surveyor should have made excesses in his survey, and in many cases he made what is known as a "chimney corner" survey; in other words, he may not have been within 100 miles of the land, but made the field notes from a map by projection.

Herewith follows a copy of the official measurements, that may interest my brothers in arms, and if there is any other information that I can give, I will gladly furnish it.

5,645,376 square varas = 4,840 square yards = 1 acre.

The square of	5,000 varas	= 1 league	=	4,428.4 acres.
" " "	3,535.5 "	= ½ "	=	2,214.2 "
" " "	2,886.7 "	= ⅓ "	=	1,476.13 "
" " "	2,500 "	= ¼ "	=	1,107.2 "
" " "	1,000 "	= 1 labor	=	177.136 "
" " "	2,688 "	= 1,280 acres.		
" " "	2,328 "	= 960 "		
" " "	1,900.8 "	= 640 "		
" " "	1,344 "	= 320 "		
" " "	950.4 "	= 160 "		

1,900.8 varas = 1 mile. 1 vara = 33⅓ ins.

To find the number of acres in any number of square varas, multiply by 177 and cut off 6 decimals.

Very truly yours, Chas. P. Scrivener, C. E.
704 Congress Ave., Austin, Tex., July 16, 1902.

Sir: As the vara question continues to bob up in Engineering News, will you permit me to say that the vara is not a constant unit, but has different lengths in different localities. "Hodgman's Manual of Land Surveying," pages 11-13, gives a more complete statement of the Spanish land measures used in California, Mexico and Texas than has been given by any of your correspondents.

Yours truly, F. Hodgman.
Climax, Mich., July 19, 1902.

Notes of Experience on Masonry Construction.

Sir: Major Mahan's paper, under the above heading, in your issue of July 17, touches on an always interesting theme.

As regards the character of masonry work at the present day, and whether masons are being ruined, i. e., whether good masons are being converted into bad ones, and if so why, it would no doubt be difficult, if not impossible, to generalize, because there would be such wide variations in different localities, work improving in some places and deteriorating in others. I am inclined to suspect, however, that on the whole the tendency is generally towards deterioration. The causes of this deterioration, if it exists, would be hard to fix upon. There are probably three considerations leading to the production of good work, namely, conscientiousness, artistic sentiment and fear of consequences, while the contrary considerations are innumerable. In the early works of magnitude in this country, such as the old Croton Aqueduct, the builders were feeling their way up from comparatively insignificant structures to such colossal masterpieces as the High Bridge, and did not dare to take any liberties with materials or workmanship. They had not yet learned how well poor stuff, badly put together, will sometimes stand up. Besides taking counsel of their fears, there is reason to think, too, that the early builders of America, contractors as well as engineers, took a more artistic pride in their monuments than is perhaps the case to-day. I refuse to admit that conscientiousness is a less potent factor now than hitherto.

While specifications are getting to assume more and more the "cast iron" type, it is to be apprehended that there is an increasing laxity in their enforcement. Also, inexperienced engineers, strong in science but weak in art, combined with incompetent inspectors, swallow camels and strain at gnats, to the demoralization of the contractor. As to the influence of politics upon contemporary stone masonry, this is a subject too deep for me to handle, and besides it principally affects one branch of the business only—the municipal.

I believe that the class of masonry destined to play the most important part in the structures of the future is machine-made concrete, mixed wet, with or without a steel skeleton. Besides its own merits, the progress of this class of work is probably advanced by considerations of strikes and combinations of skilled labor, which lead builders to regard with favor the employment of machine work and day labor.

As regards the best way to mix and place hand-made concrete, I believe the discussion is soonest ended by frankly admitting that there is no best way. First-class concrete, as far as manipulation is concerned, may be made in several different ways, all of which, however, must possess the common attribute of a thorough and intimate intermixture of the ingredients. Upon the whole, I think that as good a way as any is to mix the cement and sand dry (this should always be done), and thoroughly drench the broken stone with water, and then mix stones and mortar together without further addition of water until the mass has been well turned over. Then, while continuing the mixing, add water (by sprinkling, not dashing) until the proper fluidity has been secured. This depends upon circumstances. In a very wet foundation pit of small area good results may be obtained by pumping vigorously up to the last minute; then pulling out the pumps and quickly shoveling in the concrete without any further admixture of water, merely leveling it off, and allowing the water to rise and percolate through it. It will soon get quite wet enough, and can be settled in place by gentle ramming.

I think the throwing in of large stones in a mass of concrete is always detrimental to the work, which should be as homogeneous as possible. When time is an object, it is sometimes permissible to use them, so as to get on faster, but the quality of the work is never benefited by it. On the other hand, I believe it is often improved, particularly when using very wet concrete, by spreading here and there a layer of the broken stone used for the concrete and beating them well in. It is sometimes—perhaps generally—considered that the richer the concrete is—that is, the smaller the dose of broken stone—the better the result. I am convinced that this is a mistake, and that if the stone be hard and sharp, the more of it that can be rammed in the better, provided that they are thoroughly coated with mortar. The reason is that the stone is stronger than the mortar, the only object of the latter being to fill the voids and bind the stones together. Of course, this requires great judgment and a competent and faithful inspector, or the license would be grossly abused when the work is done by contract.

Writers on the subject of concrete making do not dwell sufficiently upon the after treatment of the material. The work is not finished when the concrete is made, mixed and rammed. All exposed surfaces must be kept constantly and thoroughly moist for an indefinite period, the longer the better. The top surface of a concrete foundation must be kept wet till it is covered by the superstructure.

E. Sherman Gould.
Yonkers, N. Y., July 18, 1902.

The Appearance of Exposed Surfaces of Concrete.

Sir: The question of the appearance of exposed surfaces of concrete is taken up in your editorial columns of July 3, and you remark that in the very large majority of cases such surfaces are disfigured by a lack of uniformity in color. As you ask for contributions from any of your readers who can furnish information as to how these difficulties may be remedied, I take the liberty of saying that the cause of the irregularity is not far to seek. It is primarily due to variations in the amount of water in the mortar of which the concrete is composed. It is readily be understood that where any excess of water is used, segregation of the coarse and fine particles will take place, with a resulting difference in color. Where a small amount of water is used the concrete is more porous, the very considerable percentage of free lime, liberated from the Portland cement in the course of setting is more readily brought to the surface at such a point. These results can be readily illustrated by shaking up a very wet mortar in a test tube and allowing it to subside and set.

The amount of water in a concrete, the face of which is to be exposed, should be neither too small or too large, but such a concrete should certainly not be dry or the exposed face will be honeycombed. I hardly remember to have seen in my experience any concrete made where the constituents were *carefully* measured or weighed and every provision taken to prevent the loss of any of the water with which the concrete was mixed. Where the greatest care is used as to the amount of water added to the mortar and to prevent its loss and where separation of the mortar from the broken stone is carefully avoided in depositing the concrete and in ramming it, the exposed surface after the removal of the molds is fairly uniform in color.

A more uniform color will always be obtained where some puzzolanic material is ground in with the cement such as slag or trass. This hydrated silicious material combines with the lime which has been liberated and prevents its washing out on the surface. Some of the best Continental authorities are now strongly in favor of grinding such material with Portland cement, especially where it is to be exposed to sea water. It seems most reasonable that this should be an advantageous way of procedure. A. Meyer, a Roumanian engineer, has lately discussed this subject most interestingly in a paper in "Bull. de la Soc. des Sciences de Boucarest," 9, No. 6 et seq., which has been reprinted in "Baumaterialienkunde," 1901 and 1902, and "Thonindustrie Zeitung," 25, No. 120 and following.

Exactness in the amount of water used in the concrete and, where the elimination of the stain caused by the free lime is considered desirable, the addition of some substance containing silica in an active form are the two steps to be taken to produce a concrete surface which should present a uniform color and pleasing appearance. The addition of the active silicious substance will probably be generally disregarded, although the tensile strength of a concrete containing 15% of such material to 85% of Portland cement was increased in 12 weeks about 90 lbs. per sq. in. over that made with plain cement. It may be added that the use of a small amount of lamp black in concrete will give a much more pleasing and uniform color than can ever be obtained with straight cement. Very truly yours,

Clifford Richardson.
New York Testing Laboratory.
Long Island City, N. Y., July 8, 1902.

Sir: In reply to the editorial request in a recent issue of Engineering News, I submit the following as a satisfactory solution of the problem of bettering the appearance of concrete walls which as ordinarily made appear streaked and not uniform in color.

Years ago the New York Central Ry. built a retaining wall about 20 ft. high in this city, and the stone being rather shaley has not given satisfaction, so that it has recently been faced with a layer of Portland concrete about 18 ins. thick, which serves also to strengthen the wall and prevent its being pushed out any more at the top. After the concrete facing had been in place some time the streaked appearance and the horizontal lines where the boards of the forms had met caused much dissatisfaction that the wall has been gone over by masons with chisels or points so as to produce corrugations. The depth of the hollows of the corrugations is about ¾-in. below the summits, and corrugations are about 2 ins. c. to c., and have a general alinement of about 1 ft. off the vertical in a rise of 5 ft. No attempt has been made to make the corrugations run in perfectly straight lines. The coping has been marked off in blocks about 4 ft. long to imitate stone coping, and for about a foot beneath the coping the concrete has been left plane, without corrugations. The general effect is exceedingly good and a wonderful improvement over the plane concrete surface. The marking of the coping into blocks, as done, was a mistake, however, for such water as lodges upon the top of the wall follows the grooves cut in the coping and carries with it cinders and dirt that are staining the face of the wall. This result might have been entirely overcome by cutting the grooves with a slight slope toward the back of the wall so that no water would flow over the face. Indeed, would it not be well in all cases, whether concrete or stone coping is used, to give the coping a slight pitch toward the rear of the wall?

In some places there are still to be seen horizontal lines in the corrugated wall, and such lines undoubtedly mark the end of one, and the beginning of the next day's work, the concrete having set. The remedy is obviously to carry a section of wall from base to coping in a single day.

Yours truly, Halbert P. Gillette.
Rochester, N. Y., July 10, 1902.

A LENS MIRROR LOCOMOTIVE HEADLIGHT.

We illustrate in the accompanying cuts a new form of locomotive headlight, which the manufacturers designate a lens mirror searchlight, and which they claim several advantages over the common forms of headlight using either oil or gas as the illuminant, with a silvered parabolic reflector to project the rays ahead of the locomotive. The new headlight or searchlight which we illustrate uses acetylene gas as the illuminant, and the rays of light are concentrated and projected by an aplanatic lens mirror exactly similar to that used in marine searchlights. In fact, it will be seen from Fig. 1, which shows the external appearance of the new headlight, that it bears a close resemblance to the searchlight so generally used on shipboard. The new headlight is, as a matter of fact, a modification of the lens mirror projector, built by the same firm for use on vessels, and its application to a new kind of service to which it appeals with the indorsement of ten years' successful service on shipboard.

Fig. 1. View of Lens Mirror Locomotive Searchlight.
Rushmore Dynamo Works, Jersey City, N. J., Builders.

Referring again to Fig. 1, it will be seen that the new headlight consists of a cylindrical metal drum having at its front end a plane glass door and at its rear end a spherical-shaped head or cover, the whole being mounted on two yoke-like legs or supports. Fig. 2 is a longitudinal section of the device, from which it will be observed that inside, at the rear end of the drum, there is mounted a standard navy searchlight aplanatic lens mirror. This mirror is a deep bowl-shaped lens of glass accurately ground and polished, and having its posterior or convex face silvered. The front or concave surface is finished to a shorter radius than is the convex surface, and the lens is, therefore, thicker at its edge than at its center, the relative dimensions being about 1 in. and ¼-in. in a 12-in. lens. The course given to the rays of light by the lens is indicated in Fig. 2, from which it will be seen that they are collected and projected in a clear solid beam and not scattered and dissipated as they are by the ordinary parabolic reflector.

As previously stated, the illuminant used is acetylene gas. To supply the gas an acetylene generator may be installed on the locomotive or the gas may be stored in cylinders which are recharged at central stations. The following extracts from a communication to us from the builders of the headlight under consideration show the present extent and success of its use and give a number of other interesting details:

We have not planned to sell a very large number of these lights for the present, but are placing them on trial on as many roads as it is possible. We have equipped two of the fastest engines on the Central Railroad of New Jersey, running between Jersey City and Philadelphia. These engines regularly run as fast as 90 miles an hour for considerable distances. The lights have given perfect satisfaction, showing up the entire roadway for nearly 2,000 ft., light-colored objects, such as sign posts, being shown up at greater distances. The engineers express themselves as highly pleased with the lights, and agree that the light would show up a box-car or a wreck on the line in ample time to avoid serious accident, even at the highest speed. We have further demonstrated, particularly on the Central Railroad of New Jersey, that while the light is fully as powerful as desired, it does not blind those who look into it, and in fact the other enginemen approve of the lamp as they can see it coming a great ways off, and can judge accurately of the speed of the train behind it. Tests are also being made upon the Erie, and we are about to ship a number of lights for trial on the Delaware, Lackawanna & Western, Southern Pacific, Great Northern and other roads.

We send you herewith photograph, Fig. 3, of an engine fitted with our light, having mounted on the pilot a steel cylinder containing 800 cu. ft. of acetylene dissolved in acetone at a pressure of ten atmospheres. The Central Railroad of New Jersey engines are now fitted with our locomotive type generator which is mounted on the smokebox just back of the light. From the water space a short loop of pipe is dropped down into the steambox, where the heat from the flue gases keeps the temperature of the water above the freezing point in the coldest weather. The valve in this pipe is opened only in severe weather. We are now furnishing all of the lights with 1¼-ft. burners, which the generator will supply for 20 hours continuously. The generator is entirely automatic. All pipes and water passages are of such large area that there is no danger of clogging up. There is no adjustment of any kind required, the water being always turned full on or full off. The water may be turned on at all times, it only being necessary to turn on the light when required. We are also furnishing these lights with automatic electric gas lighter, with two push buttons in the engineer's cab with which he may light the lamp only when required, also turn it up or down or put it out without leaving the cab. This is of some importance, as the headlights are now often lighted long before darkness sets in, and there is a needless waste of illuminant.

We have demonstrated that a powerful source of light such as the electric arc is not required, and that the acetylene flame is of ample power if the light is put where it is wanted. While the direct light from the acetylene flame lights up the right of way near the engine, the projected beam is perfectly solid, and makes a clean, sharp line where it strikes on a dark background, being in fact a perfect magic lantern picture of the flame itself. Standing behind the light there is seen in the air a solid round beam differing only in intensity from the beam of an electric searchlight. We are furnishing these headlights with the Elliott generator manufactured by the F. C. Wilson Co. of Chicago. These generators give perfect satisfaction and are recommended for all scattered service. For roads having heavy traffic we furnish the gas compressed in steel cylinders, under the system of the Commercial Acetylene Co. of New York city. The New York Central engine, Fig. 3, exhibited at the Master Mechanics' Convention at Saratoga, was equipped with a searchlight and tank holding 800 cu. ft. at a pressure of ten atmospheres.

The builders of the locomotive searchlight illustrated are the Rushmore Dynamo Works, of Jersey City, N. J., and we are indebted to them for the information from which this description has been prepared.

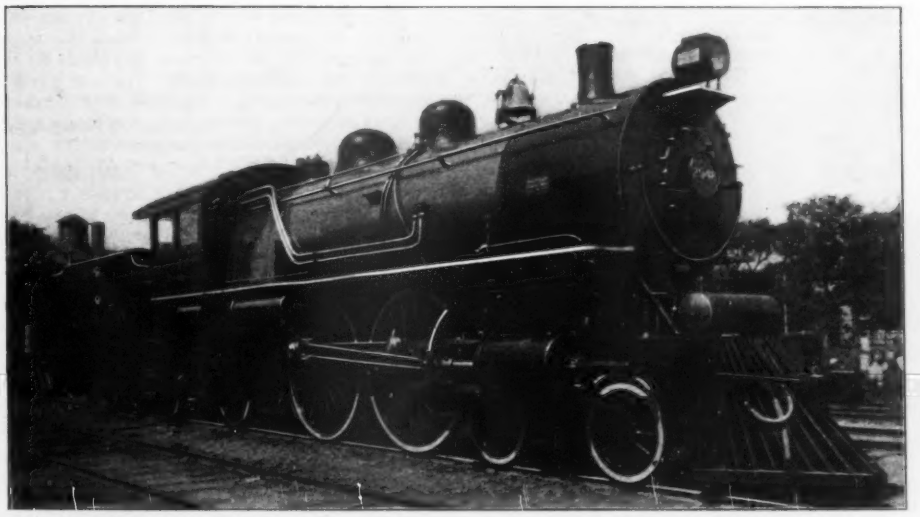


FIG. 3. NEW YORK CENTRAL & HUDSON RIVER R. R. LOCOMOTIVE EQUIPPED WITH RUSHMORE SEARCHLIGHT.

SAFETY APPLIANCES FOR USE IN CONNECTION with electric tramways are called for by the City of Dresden, Saxony. Prizes of 5,000, 3,000 and 2,000 marks will be awarded on Oct. 1.

SOME RECENT EXPERIMENTS WITH CEMENTS, MORTAR AND CONCRETE.

By Thomas S. Clark.*

In the construction of the Manhattan Railway Company's Power Station, at 74th St. and East River, New York city, during the past two years, about 40,000 barrels of cement were used. The engine beds, condensing tunnels, wall and column foundations, contain about 18,000 cu. yds. of concrete. This immense volume of concrete, together with the mortar used in the floors and walls, made the item of cement a very important one to the contractor and the company. The importance of good construction in a building where

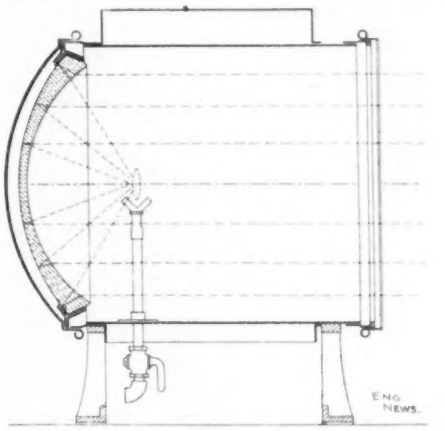


Fig. 2. Longitudinal Section of Locomotive Searchlight, Showing Interior Parts in Position.

such absolute stability and durability is demanded, required a watchful surveillance on the part of the company's engineers over every shipment of cement received for use. Recognizing this, the company maintained a field laboratory on the site, in which all cement was tested before being used; and during the twelve months that concrete construction was being carried on, over 3,500 briquettes were made and broken. Twenty-nine different brands were tested, two of which form nine-tenths of the total work.

The large amount of careful surveying, inspection, field engineering, laboratory and office work, required the services of ten or more young engineers as assistants. In line with their regular work, the cement laboratory afforded an excellent opportunity during inclement weather for investigating the action of cements under different conditions, and also for determining how different brands stood up under severe treatment, thus demonstrating the superiority of one over the other. Although the results are not entirely new and were arrived at under field conditions, they may be of value to some reader.

*Resident Engineer in Charge of Construction of Manhattan R. R. Power Station, 74th St. and East River, New York city.

RETEMPERING CEMENT MORTAR.—It is to be regretted that the practice of retempering Rosendale cement mortar after it has lain in the mason's tubs over the noon hour, is a frequent practice by builders in New York city. It is not a question whether a wall built with retempered Rosendale cement mortar will fail or not, but it is a question of getting the best wall for the money expended. To prove to the satisfaction of all concerned that Rosendale cement mortar is injured by retempering after 60 mins., the experiments shown in Table I. were made. All briquettes in like sets of same brand were made from the same bag of cement and their treatment was exactly the same, except the retempering, which was done at the end of the hour, and enough water added, as in practice, to bring the mass back to its original consistency.

TABLE I.—Showing Effect of Retempering Rosendale Cement Mortars.

Hours in air.	Age in days.	Tensile strength: Av. No. of tests.	Tensile strength: Lbs. pr sq.in.	Remarks.
		Neat Cement; Water, 28%.*		
3	1	43	139	Not retempered.
3	1	13	27	Retempered after 60 mins.
24	7	27	166	Not retempered.
24	7	20	64	Retempered after 60 mins.
24	14	20	180	Not retempered.
24	14	7	80	Retempered after 60 mins.
24	28	6	219	Not retempered.
24	28	6	94	Retempered after 60 mins.
24	56	5	322	Not retempered.
24	56	3	180	Retempered after 60 mins.
	1 Cement, 3	Sand Mortar;	Water, 14%.	
24	28	5	39	Not retempered.
24	28	5	31	Retempered after 60 mins.
24	56	5	73	Not retempered.
24	56	5	59	Retempered after 60 mins.
24	112	5	113	Not retempered.
24	112	5	56	Retempered after 60 mins.

*Per cent. of water given is the initial wetting.

The same disastrous results were obtained even when the cement was moistened every 15 mins. of the hour. Contractors have argued that if a little fresh cement is added the mortar is as good as it was originally. It is quite true that the strength is increased, but the old mortar must be considered as almost inert material. It cannot be supposed that the fresh cement has any life-giving effect upon the particles of the old cement which has passed through the first stages of set. Builders may be able to point to walls where this practice was in vogue, but there is no question that the wall built where it was not allowed is the better wall, will endure longer and stand more shock. With several brands of Portland cement under the same treatment the machine used failed to show any injury done. The results were so close together that they have been combined in Table II.

TABLE II.—Showing Effect of Retempering Portland Cement Mortars.

Hours in air.	Age in days.	Tensile strength: Av. No. of tests.	Tensile strength: Lbs. pr sq.in.	Remarks.
		Neat Cement, 18% Water.*		
3	1	54	225	Not retempered.
3	1	17	115	Retempered after 60 mins.
24	7	42	730	Not retempered.
24	7	20	779	Retempered after 60 mins.
24	30	15	816	Not retempered.
24	30	16	888	Retempered after 60 mins.
	1 Cement, 3	Sand Mortar;	10% Water.*	
48	28	5	254	Not retempered.
48	28	5	280	Retempered after 60 mins.
48	90	5	280	Not retempered.
48	90	5	292	Retempered after 60 mins.
48	180	5	327	Not retempered.
48	180	5	357	Retempered after 60 mins.

*Per cent. of water given is the initial wetting.

As with Rosendale cement there must be a limit where retempered Portland will fail, and we are inclined to believe that it is somewhere within the second hour of standing. That the retempered Portland did not fail may be explained by the fact that the time of active set of Rosendale is shorter than that of Portland. After the chemical action between the cement and the water has reached a certain point, the working of the mass with additional water disturbs the action and kills the hardening process. This point is reached sooner in Rosendales than in Portlands, and the quicker the action of cements the more injury is done by retempering. The safest rule is to allow no retempering under any circumstances.

MOLDING BRIQUETTES.—An idea has prevailed that the briquette which is packed the hardest will give the highest tensile strength at a given age. The per cent. of water used has a great deal to do with this. To be able to use force in packing the cement into the molds and apparently gain a more compact mass, the per cent. of water was materially reduced. This met with disastrous results. Not only were the tests naturally irregular, but the briquette never reached the strength attained by those made with more water and simply forced into the molds with the thumbs. Table III. shows the combined results with several Portlands. The briquettes were neat and kept in air 24 hours.

TABLE III.—Showing Effects of Low Percentages of Water on Strength.

Age in days.	Per ct. of water.	Average tensile strength, lbs. pr sq.in.	Age in days.	Per ct. of water.	Average tensile strength, lbs. pr sq.in.
7	18	722	28	18	684
7	20	680	28	20	762
7	22	638	28	22	809

It will be noted that the evil effects did not make their appearance until the 28-day test. This may be due to the fact that the first process of set is of a different nature than the long continued process of hardening. There is always a required amount of water necessary to produce the full chemical and mechanical action in a given cement, and if this amount of water is not present in the initial wetting, no amount of pounding of the briquette will make it attain the strength of one having the proper amount of water. This amount varies with different brands. It is safe to assume that concrete a little too wet is ofttimes better than that which is too dry, especially when laid in warm weather, but when forced to lay Portland concrete in freezing temperatures, the least possible water used the better.

TABLE IV.—Showing Strength of Sand Mortar Compared With Stone Dust Mortar; Portland Cement; 24 Hours in Air, 6 days in Water; Amount of Water Used, 10%.

Proportions: Cement.	Sand.	Stone dust.	Av'g tensile strength, lbs. pr sq. in.	Average No. of tests.
1	..	2	245	15
1	2	..	345	16
1	..	3	216	3
1	3	..	241	3

RELATIVE STRENGTH OF SAND AND STONE-DUST MORTARS.—Table IV. shows the results of an experiment to determine the difference in strength of briquettes made with cement and sand, and those made with cement and fine stone dust. The results are as might be expected, the stone dust being so much finer than the sand, more cement is required for a given amount of stone dust to produce the ideal state of coating completely every separate particle with cement and filling every void. If the stone of the concrete contains dust, it has not the same effect as adding more sand, because, as shown, dust mortar is weaker than sand mortar for the same proportions. One might better increase the amount of cement as well as decrease the sand, but this increases the cost of the mass. There is a marked difference between stone dust and dirt containing animal and vegetable matter, the latter having a much more deteriorating effect.

CRUSHING STRENGTH OF CONCRETE USING SELECTED AND UNSELECTED STONE.—All of the stone used in the concrete of the Power Station came from the excavation of the site. This rock contained a certain percentage of mica, but the fracture was very sharp. A small per cent. was quartz. The presence of mica being objectionable on account of the smooth surface presented to the mortar in the concrete and its low compressive strength, the stone carrying a large per cent. was rejected for use; but before any concrete was used twelve 8-in. cubes were mixed in the proportion of 1 Portland cement, 3 sand, 5 stone, using three classes of stone. These cubes were kept in air 24 hours and in water five months, then tested for compression. In the first set of six fine sand was used, the stone in each case being from 1 to 2 ins. in longest diameter. The results are averages of two specimens each.

Specimen 1.—1,595 lbs. per sq. in., Standard limestone.
" 2.—1,185 " " " Selected stone from site
" 3.— 985 " " " Rejected " " "

With coarse, sharp sand better results were obtained:

Specimen A.—1,825 lbs. per sq. in., Standard limestone.
" B.—2,145 " " " Selected stone from site
" C.—1,102 " " " Rejected " " "

After construction was under way, machine-mixed concrete of the same proportions was taken from the contractor's bucket, made int[o] cubes, and after being one day in air and [6] days in water gave a creditable average comp[ressive] strength of 1,765 lbs. per sq. in. A concret[e] 10 ins. × 10 ins. × 60 ins., of the same mate[rial] hours in air and 39 days in water, broken [on] a concentrated center load, 54 ins. between sup[ports], showed a modulus of rupture of 277 lbs. [per] sq. in. This same aggregate with a different [proportion] of Portland cement at the end of 56 days, [after] 24 hours first in air, gave a tensile strengt[h] with a direct pull of 240 lbs. per sq. in. These [beams] and cubes were taken out of the actual wor[k] and not especially made in a laboratory for the [pur]pose.

Concrete, mortar and neat cement being a b[rittle] substance, like stone and cast iron, when us[ed] as a beam and subjected to a cross-bending s[tress], failure occurs first on the tension side. In [cast] iron the modulus of rupture in cross-breaking has been found to be from one and one-half to t[wice] the tensile strength, depending, of course, upon the shape of the specimen and the distributio[n] of the material about the neutral axis of the bea[m].

RELATION BETWEEN TENSILE STRENGTH AND MODULUS OF RUPTURE.—In order to determine roughly the relation between the tensile strength of neat cement, cement mortar, stone and cinder concrete and its so-called modulus of rupture when acting as a beam under a concentrated center load, briquettes and beams were made, the latter with rectangular cross-section, using the same cement and aggregate for like sets and subjecting them to exactly the same treatment. After breaking the briquettes by direct tension, and the beams by cross-bending, it was found that the substances mentioned showed, on a fair average, that the modulus of rupture of cross-breaking was about one and one-half greater than the strength in direct tension. The following tables illustrate this fact:

TABLE V.—Showing Results of Tests of Neat Portland Cement Beams and Briquettes.

(Briquettes in tension, beams in cross breaking; beams, 1 × 1 × 8 ins.; all are averages of from 2 to 12 specimens; 24 hours in air in all cases.)

	Age in days.	Lbs. per sq.in.	Factor.
Briquettes	30	809	....
Beams	30	1,242	1.53
Briquettes	112	932	....
Beams	112	1,406	1.50
1 Portland Cement, 2½ Sand—Mortar.			
Briquettes	30	376	....
Beams	30	540	1.43
Briquettes	60	482	....
Beams	60	634	1.32
Briquettes	112	493	....
Beams	112	679	1.37
1 Portland Cement, 3 Sand—Mortar.			
Briquettes	28	282	....
Beams	28	417	1.47
Briquettes	56	328	....
Beams	56	512	1.56
1 Portland Cement, 2 Sand, 5 Cinder—Concrete.			
Briquettes	30	110	....
Beams	30	183	1.66
1 Portland Cement, 3 Sand, 5 Stone—Concrete. Beams, 3 × 3 × 30 ins.			
Briquettes	28	187	....
Beams	28	304	1.63

The fracture in the beams often showed the plane of rupture passed directly through the stones of the aggregate, so the strength of the stone was largely a factor of the strength of the beam.

HIGH STRENGTH SHORT-TIME TESTS.—It is very often the case that cement must be used within a few days after its delivery on the work and a common rule is to specify a certain fineness and tensile strength for 24 hours and seven days; very seldom is the test required to be carried beyond 28 days. Aware of this fact, cement manufacturers have been known to put upon the market a cement which will show a high tensile strength in 24 hours and seven days, and still stand up under the boiling test. This is sometimes accomplished by the use of a sulphate. Brands have been tested in the laboratory which ran as high as 1,100 lbs. tensile strength in seven days, and 300 lbs. in 24 hours. It has been our experience that such cements invariably lose strength after the second month. This adulteration seems but to exhilarate the first process of set, and when the second action of hardening takes place covering a long period of the crystallization of the salts from solution, the cement loses the strength attained at first and settles back to the natural

strength which it would probably have shown had not the adulteration been added.

TABLE VI.—Showing Results of Tests of Portland Cements Showing High Tensile Strengths in 7 Days.

Proportions Cement.	Sand.	Hours in air.	Per cent. of water.	Age in days.	Tensile strength lbs. per sq. in.
1	0	3	18	1	300
1	0	24	18	7	1,144
1	0	24	18	14	1,005
1	0	24	18	28	1,133
1	0	24	18	56	1,107
1	0	24	18	120	1,129
1	0	24	18	270	975

We regret that for these particular brands no very long-time tests are at hand, but as far as the tests are carried (Table VI.) it demonstrated beyond doubt the deceptive object of producing a cement with exceptionally high tensile strength in seven days. These brands were avoided, and now used. With these facts in view it is well to beware of cements which act in this way, and not use them until long-time tests have demonstrated their fitness.

TENSILE STRENGTH OF BRIQUETTES WITH IMBEDDED WIRE.—The now common practice of introducing metal into the tension side of a concrete beam or slab led to the experiment of placing common iron wires in the briquettes and comparing the tensile strength developed with briquettes made from the same bag of cement and subjected to the same treatment, but containing no wires. Working on the assumption that the rigidities of the two substances are to each other as their moduli of elasticity, a formula was deduced by which the tensile strength of a briquette containing a given area of wire could be computed, having given the two moduli of elasticity and the strength of a briquette containing no wires.

The wires were not broken when the cement failed, and were not strained beyond their elastic limit, while the cement reached its ultimate strength. The fact that the rigidities of the two substances are to each other as their moduli of elasticity is only true within the elastic limits, introduces a fallacy into a formula based upon the ratio mentioned. However, Table VII. gives the results of actual and computed strength of briquettes containing wires 1-16-in. in diameter and 2¼ ins. long. They agree reasonably well.

TABLE VII.—Showing Effect of 1/16-in. Common Iron Wires in Neat Portland Cement Briquettes, 1 Day in Air and 6 Days in Water.

No. of wires in briquette.	Co-efficient.	Tensile strength—Actual, lbs. pr sq.in.	Tensile strength—By formula.	Average No. of tests.
-	1.000	669	669	26
-	1.02194	671	683	23
2	1.04298	691	698	22
-	1.06447	730	712	12
-	1.08596	749	727	20
-	1.10745	782	741	20

When the briquettes containing the wires failed, the two halves separated. From this fact it would seem that the wires had slipped in the cement, probably at the instant of fracture; the cement failing first and the tension from the machine dragging the wires. It is possible for the wires to slip slightly before the cement fails, thus throwing the strain previously held by the wire all into the cement causing the fracture. The tensile strain was not large enough to stretch the wires appreciably. Experiments with anchor bolts imbedded in concrete show that the adhesive strength of the concrete increases in proportion to the depth in the mass, and when the depth is about 30 diameters the full working strength of an iron anchor bolt is developed. This puts another phase on the experiments of wires in briquettes which would call for a factor in the formula which would take care of the adhesion of the cement to the wire, depending, of course, upon the length and diameter. It is probably true that were the tension specimen long enough to admit of a very long wire, and the cement section increased, the relative effect of the wire would be greater and ultimately the wire would break with the cement. So it is that long wires in long beams so greatly increase the strength of the tension side, and the effectiveness of a wire mesh, like expanded metal, is due largely to its form, for it is impossible for the mesh to slip in the concrete, forcing, as it were, an element of elasticity into a slab containing the metal, whereas the same slab without the metal fails under a comparatively small load with hardly an appreciable deflection.

THE COST OF BRICK AND STONE BLOCK PAVEMENTS.

By Halbert Powers Gillette.*

Whether it is due to ignorance upon the part of authors, or whether it is because authors have considered cost data of no value unless acquired by personal experience, it is certain that few textbooks on streets and pavements contain enough data to enable an engineer or contractor to estimate the cost of work. The writer has therefore thought it worth while to present herewith such material as he possesses relative to the cost of brick and block pavements.

COST OF BRICK PAVEMENT.

In pavement construction the largest item of cost is that of materials, labor, except in macadam pavement, being a comparatively small item. We shall therefore consider, first, the cost of the "pavers," and at this point a word as to nomenclature may not be out of place.

The so-called "standard brick" for house building is 2¼ × 8¼ × 4 ins., and for a time brick for paving purposes were also made of the same dimensions. Within recent years the size of the standard brick for paving purposes has become 2½ × 8½ × 4 ins., and such bricks are commonly called "pavers." A larger size, 3¼ × 8½ × 4 ins., is also much used, and is known as "block." Some variations from these dimensions occur, as in Hallwood block, which is 3 × 9 × 4 ins.; and as neither the engineer nor the contractor can be sure of the exact size of brick that will be delivered, it is always necessary to secure from manufacturers a statement as to the sizes they make.

When the sizes are known there is a factor of uncertainty to the inexperienced, and that is the thickness of the grouted or tarred joints between bricks as ordinarily laid. I have found as the average of a large number of measurements that the thickness of the average joint is about ⅛-in., unless the pavers are made with projecting lugs to give a wider joint.

The accompanying table gives such data as will ordinarily serve in estimating the number of brick that will be required. Brick are occasionally laid with extremely close joints about 1-16-in. thick, in which case about 3% more "pavers" laid on edge will be required than given in the table, but close laying is not only expensive work for the contractor, but objectionable also in that it is then impossible to perfectly fill the joints.

Size of brick.	No. of brick per sq. yd. With ⅛-in. joints.	No. of brick per sq. yd. No allowance for joints.
2¼ × 8 × 4, laid flatwise	38.7	40.5
2¼ × 8 × 4, " edgewise	67.1	72.0
2¼ × 8¼ × 4, laid flatwise	37.5	39.3
2¼ × 8¼ × 4, " edgewise	65.1	69.8
2½ × 8½ × 4, " flatwise	36.4	39.3
2½ × 8½ × 4, " edgewise	57.2	61.0
3¼ × 8½ × 4, " flatwise	36.4	38.1
3¼ × 8½ × 4, " edgewise	44.5	46.9
3 × 9 × 4, laid flatwise	34.4	36.0
3 × 9 × 4, " edgewise	45.5	48.0

Byrne, in his "Highway Construction," repeatedly errs in allowing no reduction in the number of brick on account of space occupied by joints, which would cause an overestimate of about 6% in the cost of pavers per sq. yd. laid edgewise.

Having obtained the price per thousand for the paving brick, f. o. b. factory, and freight rate to destination, the weight of the bricks must be known to estimate total cost f. o. b. cars at destination. The specific gravity of paving brick ranges from 1.9 to 2.7. Tests of 12 Ohio makes show a range of 1.95 to 2.25.

Assuming a specific gravity of 2.2, a square yard of brick pavers 4 ins. thick would weigh 385 lbs., and a square foot 43 lbs., as laid with ⅛-in. joints. Whence, by taking from the bidding sheet the number of square yards of pavement and multiplying by 385, the total weight is readily ascertained; or, for all practical purposes, divide the number of square yards by 5, and the quotient will be the number of short tons of freight.

It is sometimes convenient to know that a paver (2½ × 8½ × 4 ins.) weighs about 7 lbs. and a block (3¼ × 8½ × 4 ins.) weighs 8¾ lbs.

In unloading pavers from a flat car, one man will readily throw 1,000 pavers per hour out to a man on a wagon, who will stack them in place. Where a large number of men are working under a foreman, 1,500 pavers will be handled per hour per man. In unloading the wagon, one man in the wagon tossing out brick to a man stacking them along the curb is required. With wages at 15 cts. per hour, the cost of unloading cars is therefore 30 cts. per M, and a like amount for unloading wagons.

If the wagon haul is short, it will pay to have an extra wagon at each end of the haul to save team time, for it takes two men from 20 to 30 minutes to load and the same length of time to unload a wagon holding 1,000 pavers. Over paved streets 1,000 pavers, weighing 3½ tons, is a good wagon load, and it will tax a team to the utmost to pull such a load over earth a short distance at the end of the haul. Over good earth roads about 500 pavers is a fair load. Since a team at a walk travels about 2½ miles per hour, or 220 ft. per minute, the cost of hauling over paved streets is about 30 cts. per mile per M of pavers, wages being 35 cts. per hour for team and driver, to which must be added about 25 cts. per M for lost time of team (40 minutes) during loading and unloading when extra wagons are not provided.

A brick paving gang generally consists of about 15 men, whose duties are as follows:

4 pavers laying brick;
3 laborers loading barrows and wheeling brick;
1 laborer spreading sand cushion on concrete;
3 laborers grouting;
2 " ramming;
1 laborer raising sunken brick, etc.;
1 foreman.

Such a gang will lay 2,000 to 3,000 pavers per hour, depending upon the abundance of labor available and the foreman in charge.

Force.	Cost per sq. yd. per hour, when gang lays 2,000 pavers, cts.	Cost per sq. yd. per hour, when gang lays 3,000 pavers, cts.
4 pavers at $0.25 per hour, each	2.9	1.9
3 laborers wheeling at $0.15 per hour	1.3	0.8
1 laborer spreading sand	0.4	0.3
3 laborers grouting	1.3	0.9
2 laborers ramming	0.8	0.5
1 laborer raising sunken brick	0.4	0.3
1 foreman at $0.30 per hour	0.9	0.6
Total	8.0	5.3

The above tabulated data is based upon the writer's experience, the lower cost being with a good foreman, the higher with a poor foreman.

Engineering News, May 5, 1898, gives the cost of laying pavers in Minneapolis, with wages at $1.75 a day, as being 3½ cts. per sq. yd. for removing old pavement, 3.8 cts. per sq. yd. for hauling brick, and 3.2 cts. per sq yd. for laying brick, not including sand cushion or grouting. It is frequently desirable to know what the cost will be of taking up, cleaning old brick and relaying. A gang of men, working leisurely, "by the day for the city," accomplished the following: Each laborer chipped the tar off 500 to 700 bricks in eight hours. Replacing a strip of pavement 4 ft. wide over a sewer required a gang of 17 men, employed as follows, after the pavement had been removed and concrete relaid:

	Wages for 8 hrs.	Cost pr sq yd
3 men toothing or chipping out bats	$4.50	$0.08
6 pavers	15.00	.25
2 men furnishing brick	3.00	.05
2 " ramming, etc.	3.00	.05
4 " melting and pouring tar	6.00	.10
Total	$31.50	$0.53

The average per eight-hour day by the above gang was 60 sq. yds., the best day's work being 70 sq. yds.

It seems almost incredible that the cost of such repaving was 53 cts. a sq. yd., but it well illustrates the inefficiency of day labor for a city and the high cost of such patch work.

The following is a summary of the cost of paving with brick laid on edge, wages being 25 cts. per hour for pavers and 15 cts. for laborers:

	Cost, pr sq.yd
57 "pavers" at $10 per M	$0.57
Hauling 1½ miles over earth roads	.06
Laying pavers, including labor of grouting	.08
0.18 cu. ft. = 1/156 cu. yd. of grout.*	.05
1/36 cu. yd. sand cushion at $1.08 a cu. yd.	.03
Plank to protect concrete	.01
Total net cost	$0.80
Add about 19% for profit,	.15
Contract price	$0.95

*1 Portland to 2 sand.

To this, of course, must be added the cost of grading and cost of concrete foundation. The

*791 Powers Block, Rochester, N. Y.

writer will shortly publish data of earth work cost; and in Engineering News, Dec. 5, 1901, he has already given data for estimating cost of concrete.

COST OF STONE BLOCK PAVEMENT.

While block pavement is rapidly giving way to its rivals, asphalt and brick, it will continue to be laid as a pavement for gutters, and even for streets, in certain places, and its cost therefore will be an item that engineers and contractors should know.

We have first to consider the dimensions of the blocks. When made of granite, they are split with wedges to tolerably uniform sizes; but when of stratified rock, like Medina sandstone, a carload of blocks will show wide variation in size of individual stone. In depth, of course, the blocks must be tolerably uniform, and 6 ins. depth is usually specified. In New York city 4 ins. is specified as the maximum width of granite blocks, and it may be assumed as a certainty that they will not be found less than the maximum allowed, since to split them of less width out of granite would add materially to the cost per square yard. In Rochester, N. Y., 5½ ins. is the specified maximum width for Medina blocks, but, due to the thin stratification of the stone, they frequently come 3 ins. in width. The maximum length specified is usually 12 ins., the minimum 8 ins. Granite blocks which are quite uniform in size are sold by the 1,000, and sometimes by the square yard, laid. Medina blocks vary so in size that they are sold by the square yard.

Joints are ordinarily about ½-in. wide, and are filled first with gravel or sand, into which hot tar is poured. In New York city hot gravel is first poured in to the depth of 2 ins. and hot tar poured upon it till voids are filled; then another 2-in. layer of gravel and tar is added, and so on until the joint is full. By this method one-third to half the volume of the joints is tar. In Rochester the Medina sandstone joints are first filled clear to the surface with hot sand (damp sand will not run); then men with pointed wire pins like a surveyor's "stick-pin," used in chaining, force the sand down or pick it out if there is an excess, until the surface of the sand is 1½ to 2 ins. below the surface of the block pavement. Hot tar is then poured in and fills the upper 2 ins. of the joint without penetrating to the bottom. This method gives as good satisfaction, apparently, as the New York method.

In order to economize tar, which is quite an item, the writer would suggest a combination of the two methods; that is, first fill the joint with sand to within 2 ins. of the surface, then fill the upper 2 ins. with hot pea gravel (screened) and pour in tar.

Cement grout has been used as a joint filler, but since a cement joint, once cracked, does not heal as a tar joint does, cement appears less adapted for filling the necessarily wide joints of a stone block pavement.

With blocks $3\frac{1}{2} \times 12 \times 6$ ins., there are 26 per sq. yd. where joints are ½-in. and the area of joints is 13% of the total area, and the volume of joint filler is nearly 0.6 cu. ft. per sq. yd. of pavement. If tar is worth 10 cts. a gallon, or 75 cts. a cu. ft., and one-third the volume of the joint is tar, the cost for tar alone will be $0.6 \times \frac{1}{3} \times 75 = 15$ cts. per sq. yd. of pavement.

In unloading flat cars, the stone paving blocks may be slid down an iron chute into the wagon. One man will pitch out to one man stacking blocks up in the wagon about 10 sq. yds. of paving blocks (6 ins. deep) per hour, which, with wages at 15 cts. per hour, would cost 3 cts. per sq. yd. for unloading from cars to wagon. The cost of unloading wagon and stacking up on sidewalk will be about the same.

Assuming that extra wagons are not used, but that the driver works at loading and unloading, we arrive at the total cost of hauling as follows:

FIG. 1. VIEW OF SEWAGE FILTER BEDS, ISLAND PARK RESORT, ROME, IND.

A wagon will carry not much to exceed 6 sq. yds. (6 ins. deep) of blocks weighing about 5,400 lbs. over paved streets, and if only one man assist the driver loading and unloading, it will require about one hour and a quarter to load and unload 6 sq. yds. With wages of driver and team at 35 cts. an hour and of laborer at 15 cts., we have the fixed cost of loading and unloading about 10 cts. a sq. yd. The cost of hauling will be about 5 cts. per sq. yd. per mile of haul (lead) over pavements and 10 cts. over earth roads.

After the blocks are stacked up at the sides of the street they must be laid out on edge in the street in advance of the pavers and assorted into sizes of uniform thickness, which laborers using wheelbarrows will do at a cost of about 3 cts. a sq. yd. Two skilled pavers, with one laborer as a helper to supply stone, form a gang. A paver will lay 5 to 7 sq. yds. an hour; 6 sq. yds. may be taken as an average, which, with pavers' wages at 30 cts. an hour and labor at 15 cts., makes cost of laying 6 cts. per sq. yd. Following the pavers, comes a gang of 3 men ramming and raising sunken stone, 1 screening sand for joints, 2 heating sand and tar, 1 wheeling sand for joints, 1 sweeping sand into joints, 7 poking sand down into joints and digging out excess, 5 filling upper 2 ins. of joints with tar, making a gang of 23 men following the pavers, and with wages at 15 cts. an hour, such a gang covering 60 sq. yds. an hour, makes the cost of ramming and filling joints 6 cts. a sq. yd. Summing up, we have for the total labor cost:

	Per sq. yd.
Loading and unloading inclusive of lost team time	$0.10
Hauling 1 mile	.05
Distributing blocks	.03
Laying	.06
Filling joints	.06
Foreman at 40 cts. per hr., 30 sq. yds.	.013
2 water and errand boys	.007
Total, labor	$0.30

Cost of Medina Block Pavement.	Per sq. yd.
⅛ cu. yd. street excavation	$0.15
6-in. concrete foundation	.50
1/18 cu. yd. sand cushion in place at $1.08	.06
Medina block (6-in.) f. o. b. Albion, N. Y.	1.15
Freight to Rochester	.07
Unloading, hauling and laying	.30
1.5 gallons tar at 10 cts. a gallon	.15
1/50 cu. yd. sand for joints	.02
Total	$2.40
Add for contractor's profit	.25
Total cost	$2.65

It is obvious that variations in cost one way or the other may occur, according as the [illegible] is well or poorly managed, but it has always seemed to the writer rather incongruous that authors of text-books upon so purely economic a subject as highway construction have been content to publish only the most meager of cost data, if any at all. Text-books are certainly written as guides to the inexperienced or to the forgetful, and this little that could be of more value to either than cost data; yet that little is denied them; whereinstead they are given a historical review of the road-making art, or the chemical constituents of materials that they would not recognize if seen. Moreover, an engineer is incapable of designing an economic pavement unless he knows the approximate cost of every item of materials and labor entering therein.

SEWAGE PURIFICATION WORKS AT ISLAND PARK RESORT, ROME CITY, IND.

By Geo. S. Pierson, M. Am. Soc. C. E.*

Island Park Resort is located upon an island in Sylvan Lake, and is owned by the Pennsylvania Central Railroad Co. Sylvan Lake is a sheet of water containing 700 or 800 acres, and having a watershed of about 35 square miles. On the shores of the lake are numerous other resorts. The lake is an artificial one, and the dam which forms it is the roadbed of the Grand Rapids & Indiana R. R., a part of the Pennsylvania system.

The surface of the lake has been raised 21 ft. above its normal level by the dam. The runoff from the watershed of the lake during the summer months is ordinarily not sufficient to maintain the surface of the lake at a constant level, and the waste gates are usually closed early in the season and the water kept as nearly at its maximum elevation as possible.

Island Park is connected with the main land by a pile bridge. Its surface lies at a considerable elevation above the lake, so that it was possible to lead the sewage to a disposal area below the dam, and for a portion of the way the sewer consists of an iron pipe fastened to the pile bents of the bridge at about the floor level.

Below the dam is a lake several acres in extent, an arm of which backs up to the foot of the wasteway, and into this arm of the lake the tile drains from the sewage disposal area discharge. This lake lies to the north of the disposal beds, and is shown in the view Fig. 1.

Years ago the dam which forms Sylvan Lake gave way, and below the break was formed, at that time, a bar of well washed, coarse sand of very even texture. This was deposited near the foot of the bluffs to a depth of 5 or 6 ft. Upon this bar are located the sewage disposal beds. Upon the side of the beds, towards the bluff, a narrow strip of clay was found at a depth of 2 or 3 ft., and this was excavated and removed and the deficiency of suitable material was supplied from a sand bed found in the face of the adjoining bluff.

The quantity of sewage varies greatly at different times, as it is contributed entirely by resorters. During the early and late part of the season there are but a few hundred persons on the grounds, and upon special days as many as 5,000 people have been cared for. During the winter season the disposal plant is not in operation, as at that time the waste gates are partially open and there is a strong current in the stream below the waste weir and the amount of sewage is very small, being limited to the amount which comes from the water closets in the railroad station.

The disposal plant consists of a septic tank, combined with purification beds. The general arrangement of the plant is shown by Fig. 2.

The septic tank, Fig. 3, is divided by a central wall into two compartments. The first compartment is the septic tank proper, and the second compartment is a collecting chamber in which the sewage is held, as it overflows the weir, until it reaches the level indicated, when it is automatically discharged by a siphon upon the purification beds. There is, however, a by-pass from this collecting chamber leading directly back into the main sewer and thence to the stream, so that

*Kalamazoo, Mich.

...ning a valve in the bottom of this chamber, ...rification beds may be put out of service ...e effluent from the septic tank led directly ...e stream.

...intercepting chamber, or septic compart... ...f the tank, is provided with a valve at its ... for the removal of sludge which may be ... out upon the sludge beds shown in Fig. 1. ...e done at the close of the season, when the ...s put out of service.

...e is a fall of several feet between the bot... ...f the tank and the surface of the filter beds. ...are two beds, each 100 × 60 ft., containing

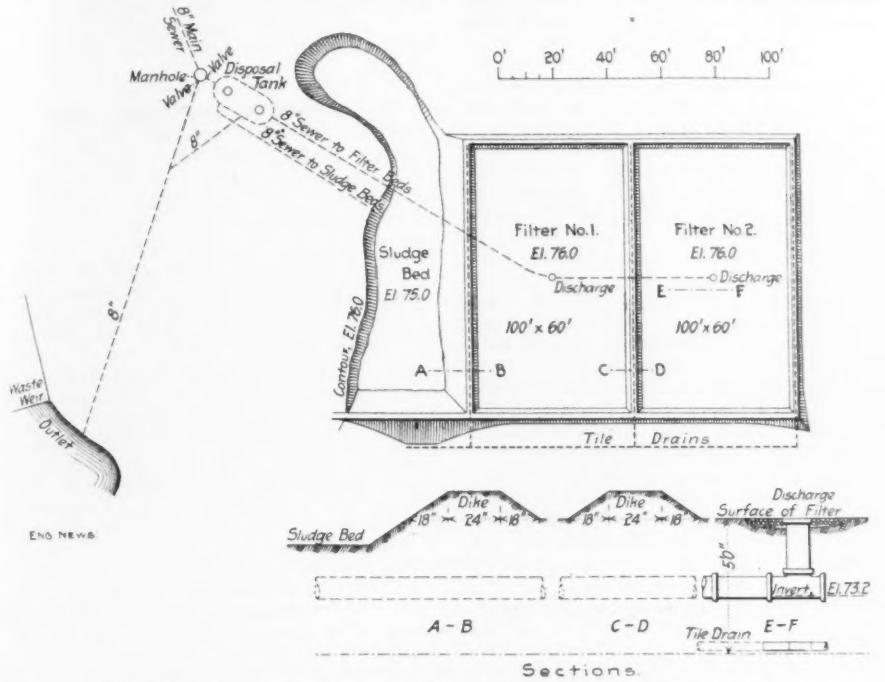


FIG. 2. GENERAL PLAN OF SEWAGE DISPOSAL WORKS AND SECTION OF FILTER BEDS, ISLAND PARK RESORT.

5 ft. or more in depth of coarse, clean sand. These are underdrained by tile drains lying beneath the embankments, and the underdrains discharge into the stream at the foot of the wasteway.

The sewage is discharged upon the beds at the center through a riser pipe. The beds are graded with a very slight downward inclination from the center towards the sides, in order to equalize the distribution of sewage upon the beds. The sewage sinks rapidly into the sand, however, and the inclination is barely sufficient to bring the sewage to the embankments before all of it has disappeared beneath the surface. During a single discharge no portion of the beds is covered to a depth of more than 1 in., and as soon as a blanket of sewage is applied to the beds countless air bubbles may be seen making their way up through the film of sewage.

At the time when the greatest number of people are upon the grounds the collecting chamber has, during certain parts of the day, discharged as often as once in 1¼ hours, and at this time the sewage has disappeared below the surface of the sand in 10 minutes or less. This is a rate of application of about 300,000 gallons per acre per day, and is probably equal to a continued rate of 200,000 to 250,000 gallons per day. The beds are in operation one at a time, and during the past season each one has been operated continuously for one week and then rested a week.

There has been no disagreeable odor about the beds at any time, and the effluent has been uniformly good in appearance. As before remarked, the flow of sewage is extremely variable, and the time during which the sewage is subjected to septic action varies between quite wide limits. Probably the minimum time, considering both compartments of the tanks, is about two hours. Early and late in the season it may be as much as 16 to 24 hours. It will be observed that the manner in which the sewage is applied to the purification beds at the time of greatest flow is particularly favorable to thorough aeration and to the purification of comparatively large quantities of sewage upon a limited area.

The plant was built with the writer as engineer, and was put in operation early in July, 1901, and within six weeks septic action was very pronounced.

THE NEED OF TECHNICAL HIGH SCHOOLS IN OUR EDUCATIONAL SYSTEM.*

By Victor C. Alderson.†

The existing engineering schools of the United States supply, to only a limited extent, the needs of modern industry, since they furnish merely the highest grade of workers, as does the Zurich Polytechnicum and the technica at Winterthur, Bienne and Burgdorf, in Switzerland. They furnish a technical training not for the many but only for the few. What should be done for the great army of workers in our industries, who need the skill of the mechanic, together with sufficient intelligence and training to understand the directions of the professional engineers above them? Their number is legion. At the present time this country makes little or no adequate provision for their instruction. This is the realm of secondary education. Whenever we, as a nation, approach the subject as the Swiss have done, from a practical commonsense, industrial standpoint, and build our industries on the solid foundation of science, as exemplified in technical education, then our industrial supremacy will be assured.

The most ringing note on this subject in recent years was sounded by the Advisory Committee invited by the trustees of the Carnegie gift to present a plan for the technical school which Mr. Andrew Carnegie proposed to establish in Pittsburg. After considering all phases of the question this committee recommended the organization of three schools to be called respectively the Carnegie Technical College, the Carnegie Technical High School, and the Carnegie Day and Evening Classes for Artisans. The second of these schools was to be most radical. The Carnegie Technical High School as outlined would extend the scope of the present high school to include, besides the subjects ordinarily taught, engineering principles, steam engine and central station practice, pattern-making, machine-tool work, blacksmithing, steam fitting, surveying, machine design, instrument-making, founding, photography, glass-blowing, and such other subjects as the local industries might demand. The establishment of such a school would be the Americanization of the foreign trade and industrial school; if it were copied and made general it would solve for us the question of secondary technical education.

In considering so radical a measure some important features should be emphasized in order to avoid misapprehension. The main idea in such a plan would be to take a boy just graduating from the grammer school and give him a good secondary education, together with a training on one or more technical or trade lines.

Much of the laboratory, drafting-room and testing work now done by the technical colleges could be incorporated into the courses, and we should have technical high schools as real "people's colleges." There can be no reasonable doubt that our technical education in the United States is weakest in this spot. In our high-grade institutes of technology we are training the commissioned officers of our industrial army, but the great mass of noncommissioned officers and privates are left uncared for. As indicated in the report of the Carnegie committee, technical education may be said to run parallel with the general lines of education, and be divided into three parts, corresponding to the grammer, high school and college grades of the established system. The lowest grade is generally picked up in the shop by boys without special training, who have had merely a grammer school education. It is represented in Switzerland by the Sunday, holiday and evening schools for artisans. It develops the "practical man." The highest grade is represented by the polytechnicum and technica in Switzerland and by technical colleges and institutes of technology in this country. These represent the phase of technical education that demands thorough knowledge of mathematics and the sciences, and is distinctly professional in character. Between these two extremes lies the region of secondary technical education which is represented in Switzerland by the trade school and the specialized technical school. In the United States it is represented by more or less feeble efforts in a few trade schools, in a limited number of private institutions aimed to help the workingmen, and in night schools.

Besides these instrumentalities there is another, arisen only within the past few years, which for pure bigness eclipses all other efforts—the schools of correspondence.

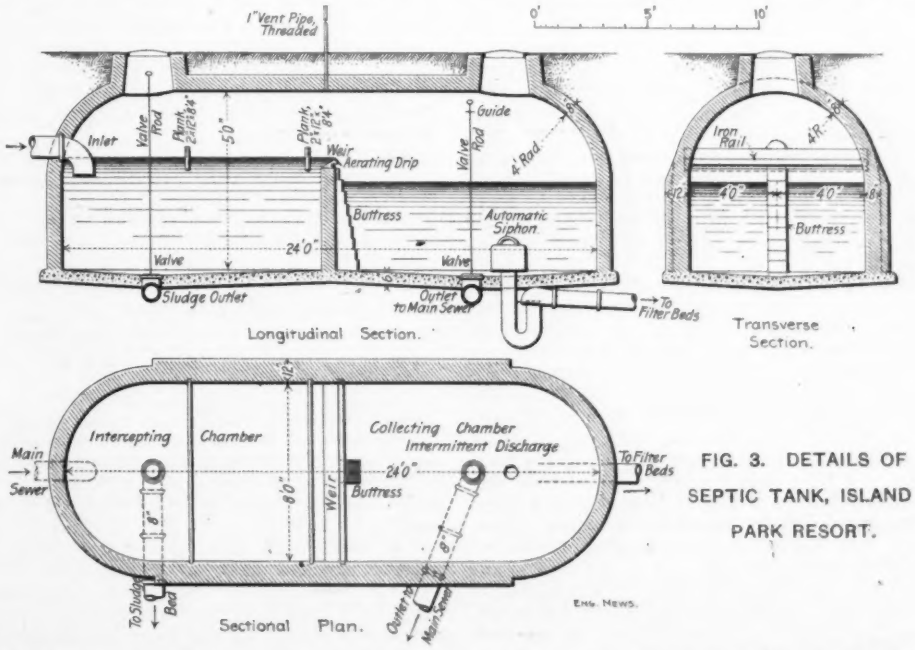


FIG. 3. DETAILS OF SEPTIC TANK, ISLAND PARK RESORT.

*Extract from a paper on "The Economic Need of Technical Education" in the "Journal of the Western Society of Engineers" for June.

†Dean of Armour Institute of Technology, Chicago.

While our educators have been discussing mere theories and methods and have been building a Chinese wall about their so-called superb school systems, shutting out all who were too large to walk through the narrow gateways which they themselves had made, private enterprise has discovered that half a million young Americans outside the walls were hungry for a technical education. Since they were forbidden to enter the sacred city, technical education was sent out to them. When the history of education shall have been written, no greater reproach will rest upon the educators of this decade than their failure to hear the call of this multitude for an education suited to their needs. Technical education is one of the greatest needs of an enlightened democracy and should not be left to private enterprise.

With state normal schools where young men and women can be trained for teaching, with state universities furnishing instruction in agriculture, dairying and stock-raising, besides training engineers and librarians—technical education supplied at state or national expense—it is evident that we are irretrievably committed to the policy of providing technical education at public expense.

If technical education is a good thing for one class it is equally good for others. Hitherto the ranks of such workers have been supplied by the influx of foreigners trained abroad, aided to some slight extent by apprentices from selected industries. But we should not, as a nation, depend upon any such uncertain supply. We should follow the example of Switzerland and, recognizing the dependence of national prosperity upon technical education, set about the task of providing an education for all classes of workers suited to their lives. The technical high school, if properly equipped and put in close relationship with the trades and industries, will satisfy this national need; it will not be a copy of the European trade school, but rather an adaptation of the trade school which will be in harmony with American thought and American educational ideals.

WIND VELOCITY AND FLUCTUATIONS OF WATER LEVEL ON LAKE ERIE.

Bulletin J of the Weather Bureau of the U. S. Department of Agriculture contains an article with the above heading, prepared by Alfred J. Henry, Professor of Meteorology, under the direction of Willis L. Moore, Chief of the Bureau. This report deals with the character and frequency of the storm winds prevailing on Lake Erie, the changes in water level produced by them, and the possibility of predicting the occurrence of the most pronounced changes in level at the eastern end of the lake; and it is illustrated by a series of profiles showing the hourly and daily fluctuations in levels at Buffalo, N. Y.

In its physical features, Lake Erie is about 250 miles long and 60 miles wide in its greatest dimensions, and the area of the lake is about 10,000 square miles. The bottom contour divides the lake into three great basins—the western, covering about 1,200 square miles, with comparatively level bottom and an average depth of 30 ft.; the middle basin, covering about 6,700 square miles, with a shelving bottom, gradually increasing the depth to 80 ft., and the eastern basin, with 2,100 square miles and a greatest depth of 180 ft., off Long Point.

The prevailing winds are westerly. At Detroit 69% are from a westerly quarter; at Cleveland, 43%, and at Buffalo 61% are from the same point. The frictional action of these winds piles up the water on the shore directly opposed to it, but the currents in the Great Lakes produced by the winds are feeble in comparison with those of the ocean. The area of water is relatively small as compared to that of the land. On account of the shallowness of the water at both ends of the lake, the disturbance in level due to the winds is sometimes a serious menace to navigation. For many years the U. S. engineers have maintained a tri-daily eye observation of lake level, and in recent years automatic gages have performed the same office, and from these the charts named have been prepared, referred to mean tide level at New York.

The surface of the lake is never in absolute repose. The first effect of a strong wind seems to be to transfer from one end of the lake to the other sufficient water to disturb the condition of hydrostatic equilibrium which existed previously. After the maximum force of the wind has been exerted the lake tends to return to its state of stable equilibrium, and this state is reached by a series of rockings of the water of the whole lake about a nodal line passing through the center of the lake, the water at either end rising and falling until the condition of rest is attained. This phenomenon is the so-called "Seiche" of Lake Geneva, where it was first observed, and the term simply means any rythmic oscillation of water level of short duration obviously not produced by fluctuations in the water supply to the lake. Prof. F. A. Foral, of Lausanne, has exhaustively investigated this phenomenon, and formulas are laid down for fixing the time of oscillation.

The report details the effect upon lake levels of the storm of Dec. 12, 1899, when the wind reached a maximum velocity of 42 miles per hour. Under the effect of a southeasterly to southern wind, the water at the west end of Lake Erie, at Amherstburg, rose from 18 ins. to 27 ins. above zero; from that point it fell, under a strong southwest wind, to 20 ins. below zero, a range of 47 ins. in 18 hours. At Buffalo the water rose 5 ft. in nine hours during the same storm, or to 6½ ft. above zero. During the storm of Nov. 21, 1900, the west wind reached a velocity of 80 miles per hour at Buffalo, and continued to blow for 6¼ hours with an average velocity of 60 miles. The level of the lake rose 8.4 ft. above the level preceding the storm, but it fell to a stage 2 ins. below the pre-storm level in 16 hours as a complete period of oscillation. During the same storm the level fell at Amherstburg 4 ft. 7 ins. At any one time the extreme difference in level between the two ends of the lake was 13 ft. 1 in. The storm of Sept. 12, 1900 (the Galveston hurricane) showed a wind velocity of 65 miles per hour and an oscillation of 7 ft. 2 ins. at Buffalo, the complete oscillation occupying less than 16 hours.

Strong easterly winds rarely prevail over Lake Erie, though such winds lower the water at Buffalo and raise the level at Amherstburg, at the west end. The easterly storm of Feb. 12, 1894, with a maximum wind of 21 miles for a short time, caused a maximum depression of 5 ft. 2 ins. in the surface level.

DRAWING OFFICE RECORD OF WORK; INDIANA BRIDGE COMPANY.

In the management of bridge and structural works it is very important that a complete and readily accessible record should be kept of the progress of work on each individual contract, in order that each may be pushed through in its turn or have its progress expedited as required. The office of the Indiana Bridge Co., at Muncie, Ind., contains a very complete and handy record of this kind, which was devised by Mr. J. R. Marsh, Chief Engineer, and a description of which will interest many of our readers.

On the wall of the engineer's office is a board about 8 ft. long and 2½ ft. high, divided into six panels about 16 ins. wide. The first two of these, at the right, are headed "Work Taken, but Not on Program for Preparation in the Shop." The remaining four panels, reckoning to the left, are headed as follows:

"Program of Work to be Prepared for Shop."

"Drawings Made and Checked, and Templets Made."

"Work in Shop, or Completed but Not Shipped."

"Work Shipped and in Process of Erection."

Across the top of each panel is a slip of paper ruled and lettered as follows, forming headings for 13 columns of varying width:

Contract No.	Checked by, and date.
With whom contract made.	Templets made, date.
Place.	Taken in shop, date.
Description of work.	Shipped, date.
Date for completion.	By whom erected.
From whom material ordered.	Remarks.
Drawn by, and date.	

Each panel of the board has two rows of bent nails, forming rests for a series of horizontal slips of drawing paper about ½-in. wide and 15 ins. long, ruled to correspond with the 13-column headings above noted. A slip is filled out (as far as possible) for each piece of work when the contract has been taken, and is filed in one of the two right-hand panels. Each week a program is made up of work to be got ready for the shop, and the slips representing this work are transferred to the third column, so that the engineer and chief draftsman can see at a glance what work to arrange for. When the drawings for any one contract are completed and checked, and the templets are made, the slip representing that contract is filled out in the proper spaces and then transferred to the fourth panel. When the work is in the shop, or completed but not shipped, it is transferred to the fifth panel; and when the work is shipped and in process of erection the slip is transferred to the sixth panel.

When the bridge or other structure is completed, the slip representing it is removed from the board, and copied partly into a contract record book in which is kept short descriptions of each contract, and partly in a record kept by the chief draftsman. The part which is copied in the latter record is that which pertains particularly to the date of the drawing, and the dates of checking and progress through the shops. These records, with the filed plans and lists of material, become the permanent records of that particular contract.

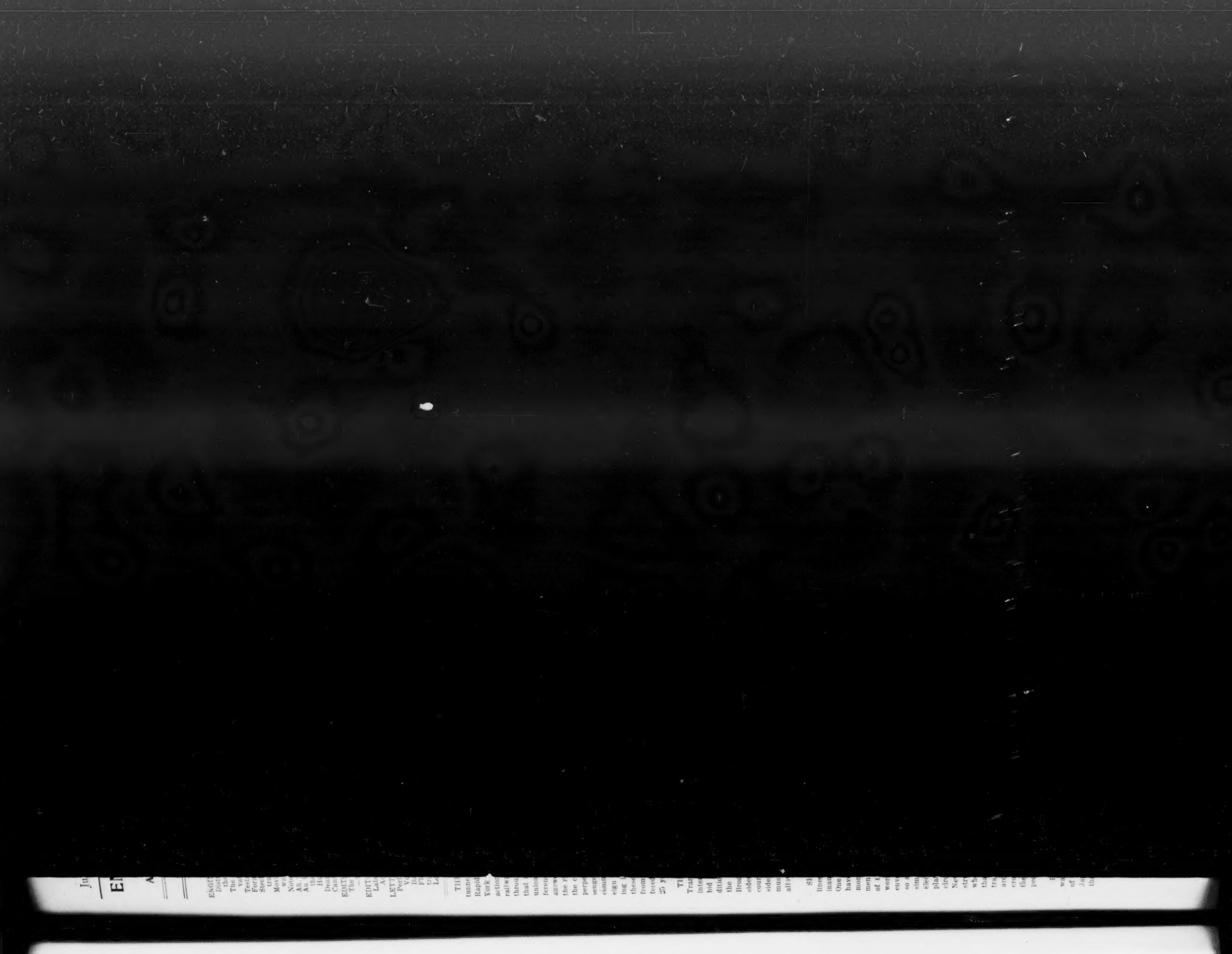
NOTES FROM THE ENGINEERING SCHOOLS.

ARMOUR INSTITUTE OF TECHNOLOGY.—The Year Book for 1902-1903 is an octavo book of 142 pages, containing lists of the faculty, committees, lecturers, instructors, etc., with the requirements of admission and the curriculum of general studies. There is also a list of the graduates since 1897. The technical college courses in civil, mechanical, electrical and chemical engineering and architecture are outlined, together with the courses of the Armour Scientific Academy, which prepares students for the technical college or for similar institutions. The Institute was founded in 1892 by the late Mr. Philip D. Armour, of Chicago, giving courses in mechanical and electrical engineering; civil engineering was added in 1899, and the course in chemical engineering in 1901. The new machinery hall, the gift of Mrs. P. D. Armour, is now under construction. In addition to the educational work, the services of the laboratories and instructors are offered for tests and investigations for commercial purposes.

THE LAKE SUPERIOR ORE OUTPUT, for 1902, will probably reach 25,000,000 gross tons. The shipments to July 1, 1902, aggregated 8,889,833 tons, against 4,963,608 tons for the same period last year.

A NEW BALTIMORE & OHIO RAILWAY PIER, at Locust Point, Baltimore, is to be built for the use of the North German Lloyd Steamship Co. The pier will be 800 ft. long and 160 ft. wide; with 32 ft. of water on either side. On the pier will be a shed 800 ft. long, 148 ft. wide and 50 ft. high to the eaves. This building will be equipped with electric light, two electric elevators, steam heating, etc.

THE LAKE SUPERIOR FREIGHT MOVEMENT, through the Sault Canal, now aggregates nearly 5,000,000 tons per month, and the 30,000,000-ton record for the year will probably be exceeded. Ten years ago the annual aggregate was 10,000,000 tons. Up to July 1, the total freight amounted to 11,486,501 net tons; the principal items of freight being anthracite and bituminous coal, iron ore (1,594,859 tons), wheat and flour. The east-bound freight amounted to 9,529,439 tons out of the above total.

COMPLAINTS AGAINST THE STORAGE-BATTERY cars on the 34th St. surface line in New York city have been taken up by the Health Commissioner of the city. The batteries give off fumes which pass into the car, and which by irritating the membranes of nose and throat often greatly inconvenience passengers. The Commissioner has called upon the Interurban Street Railway Co., who operates the line in question, for an abatement of the nuisance, and threatens to stop the operation of the storage-battery cars if no remedy is forthcoming. The company replies through its counsel that it is unable to do anything against the fumes, and that the Commissioner has no jurisdiction anyway, the motive power being virtually protected by the franchise of the line.

LONGITUDE FINDING BY WIRELESS TELEGRAPHY has been tested by the U. S. Coast and Geodetic Survey, with a view to its use for this purpose in countries—like Alaska—where there are no telegraph lines or cables. The tests were made between the Marconi station at Sagaponeck, at the eastern end of Long Island, and the U. S. Survey schooner "Eagre," equipped for the purpose. From a point 30 miles east of the station half-hourly communication was kept up until the last intelligible message was received at a distance of 63 miles. The particular feature tested was the method of sending time-signals by means of a break-circuit chronometer included in the battery circuit on the schooner; by this each second-break on the chronometer was transmitted to the shore station. The results seem to indicate that regularly timed signals can be sent in this manner at a greater distance than is possible for verbal messages by the Morse code.